Radio, Electronics and Communications

FORMERLY "RADIO & ELECTRICAL REVIEW" — WIDELY KNOWN SINCE 1946 AS "R. & E."

MPL

In This Issue . . .

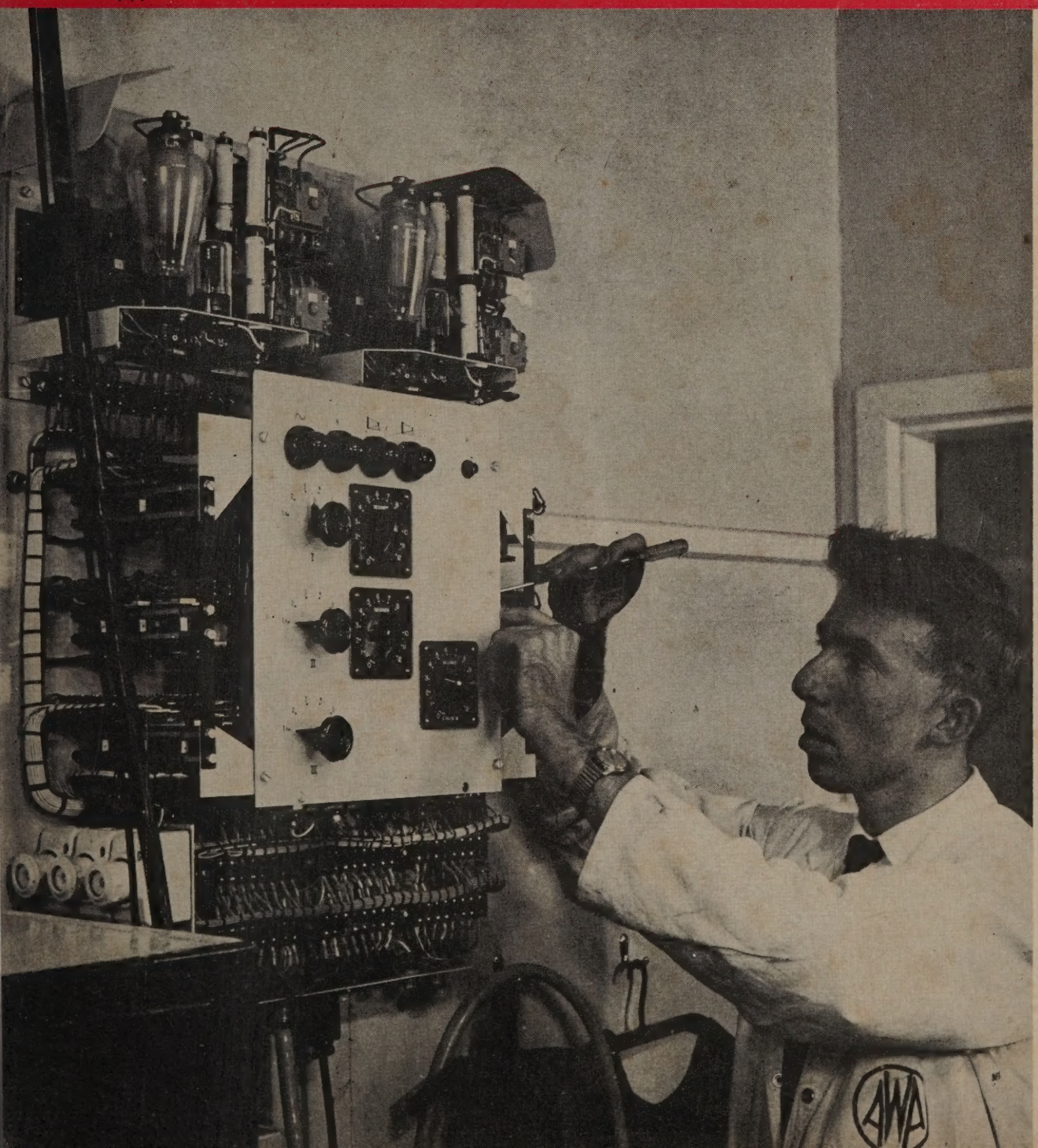
- A Low Noise Amplifier.
- National Electronics Research Council.
- An Introduction to Spectrum Analysers.
- Europe's First Micro-Computer.
- Book Reviews; Listening Post; Circuit Feature.

PUBLISHED MONTHLY IN THE INTERESTS OF THE N.Z. ELECTRONICS INDUSTRY FOR ALL LEVELS, FROM PROFESSIONAL TO AMATEUR.

VOLUME 21 NUMBER 2

APRIL 1, 1966

PRICE 2/6



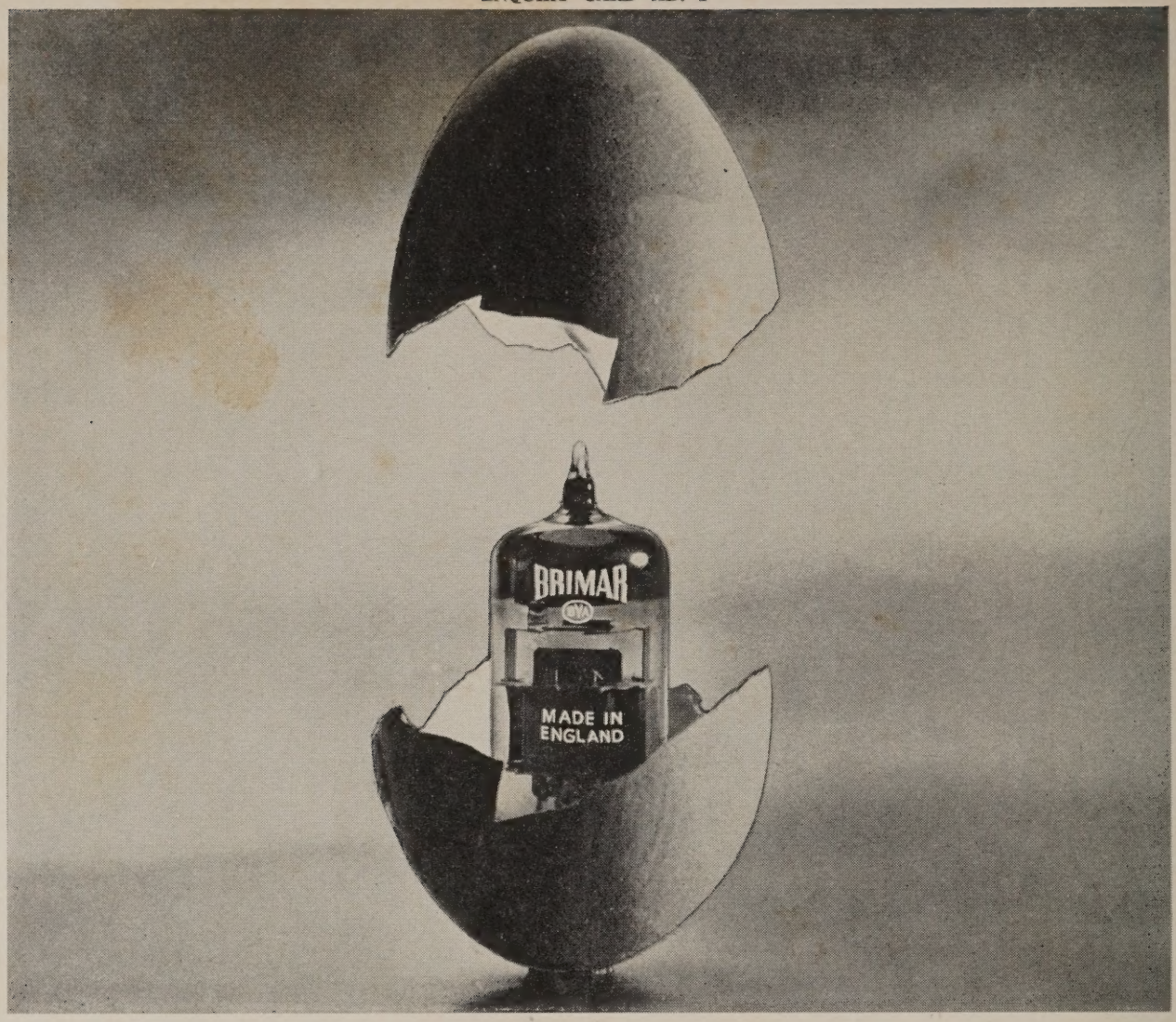
AWA

at work in the hospital

AWA

see page five

ENQUIRY CARD AD. 1



The shell of an egg contains the secret of reproduction. So too, in a different sense, does a Brimar valve. For true-to-life reproduction and consistent reliability,

better rely on –

STC

BRIMAR

N.Z. Distributors:-

Standard Telephones and Cables (Pty.) Limited AN ITT ASSOCIATE

Auckland, Box 571; Upper Hutt, Box 140;

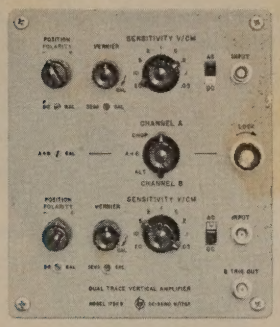
B.14

ENQUIRY CARD AD. 6

An Oscilloscope easily tailored to your needs

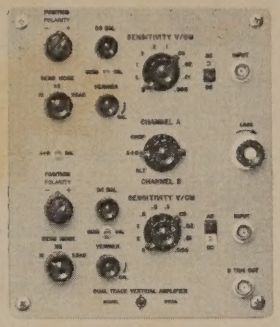
1750 B
50 mHz Dual Trace

Maximum Sensitivity is 50 mV/cm. Simplified triggering ensures stable dual trace display.
Price: £170.12.6

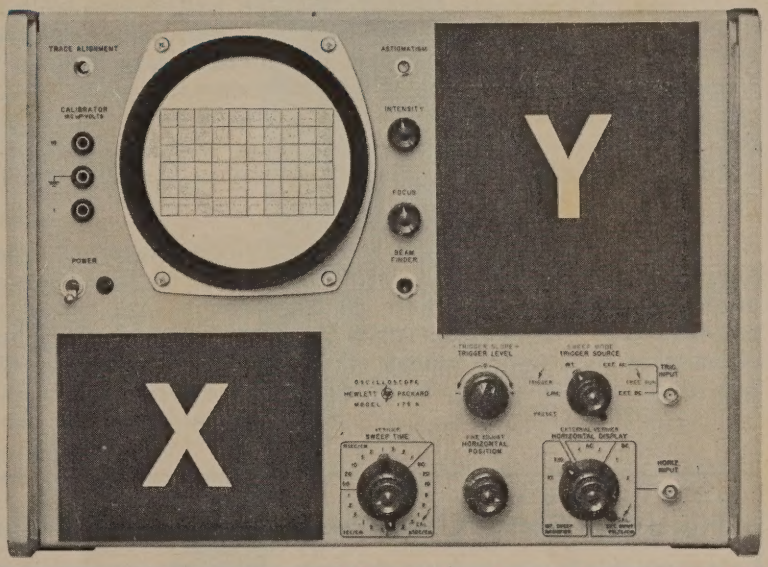


1775 A
High Sensitivity Dual Trace

With one plug-in: High Frequency (50 mHz, 10mV/cm) or Low Level (20 mHz, 1 mV/cm) operation. DC or AC coupled. Simplified triggering as in 1750 B.
Price: £301.17.6

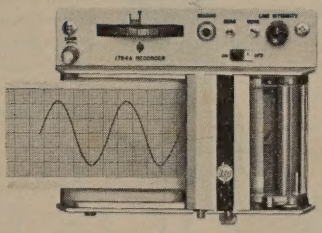


the hp 175A DC – 50 mHz



1784 A
Strip Chart Recorder

Just push a button to automatically record repetitive waveforms to 30 mHz. Cost is 1/20th that of standard photograph.
Price: £406.17.6



	175A Oscilloscope	(without plug-ins)	£695.12.6
	ADDITIONAL PLUG-INS FOR 175A OSCILLOSCOPE		
Y	1751A Single Channel Amplifier	50 mHz 50 mV/cm	£84.0.0
	1752B High Gain Amplifier	30 mHz (or 40 mHz) 5 mV/cm (50 mV/cm)	£149.12.6
	1754A Four Channel Amplifier	40 mHz 50 mV/cm	£312.7.6
X	1781B Sweep Delay Generator	offers four different sweep modes	£170.12.6
	1782A Display Scanner	for transferring CRT picture to x–y–recorder	£223.2.6
	1783A Time Mark Generator	supplies 10μsec, 1μsec, 0·1μsec markers with 0·5% accuracy	£68.5.0

Prices are subject to change without notice. Duty paid. Delivered anywhere in N.Z.

SAMPLE ELECTRONICS (N.Z.) LTD.
8 Matipo St., Onehunga, Auck., S.E.5., Phone:- 567-356

HEWLETT hp PACKARD
An extra measure of quality

SERVICE AND CALIBRATION FACILITIES PROVIDED. SPARE PARTS ALWAYS AVAILABLE

ENQUIRY CARD AD. 4

An Extraordinary 2-c to 2-Mc Oscillator

Million-to-one frequency range.

Distortion is less than 0.25% from 50 c/s to 50 kc/s, even at full output and under short circuit conditions.

Frequency characteristic is flat within ±2% from 20 c/s to 200 kc/s.

Output is over 20 V into open circuit, 160 mW into 600 Ω.

Transistorized, capacitance-tuned RC Wien-bridge oscillator and power supply are completely contained in a 8" x 6" x 8" package.

These features make the new GR Type 1310-A Oscillator an outstanding instrument for day-to-day applications. **But, what definitely puts this oscillator in a class by itself is an entirely new feature by which its frequency can be synchronized with an external signal.** Also, the oscillator can itself be used to furnish a sync signal to other equipment. Thanks to this sync provision, unique in an inexpensive oscillator, the new Type 1310 has a much wider range of application than the ordinary oscillator.

In a nutshell, the 1310-A now brings the small size, mechanical ruggedness and reliability of transistorized circuitry to a wide-range, general-purpose instrument. It offers all the benefits you expect in a modern, two-feedback- RC oscillator including high accuracy and infinite resolution of variable capacitance tuning — plus the new frequency-synchronization provision — all at a surprisingly low price.

Here Are Some Uses For Oscillator Synchronization:

as a tracking narrow-band filter to reduce hum, noise, and distortion in a signal;

a source of amplitude-modulated signals;

an automatic phase-controlled oscillator to reduce frequency modulation or jitter;

a single-frequency levelling amplifier;

a phase-locked, sinusoidal frequency multiplier;

a phase shifter;

a narrow-band isolation amplifier;

an ampuitude-modulation filter.

Frequency

Accuracy: ±2% of reading

Stability: Typical drift after warm-up, 0.001% short term (1 min) at 1 kc/s.

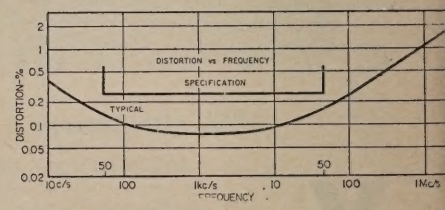
Synchronisation: ack provided for external phase-locking signal. Locking range is about ±3% for 1-V, rms, input reference signal over entire 2-c to 2-Mc range. Locking ranges up to 40% can be used.

Output

Voltage: Over 20 V, open circuit; continuously adjustable attenuator (approximately 50 dB).

Amplitude Stability: Typical drift after warmup, 0.02% short term (1 min).

Impedance: 600-Ω



Distortion: As indicated. Hum less than 0.02% independent of attenuator setting.

Synchronization: High-impedance, constant--amplitude, 0.8 V, rms, output for use with oscilloscope, counter or other oscillators.

General

Power Required: 105 to 125, 195 to 235, or 210 to 250 V, 50 to 400 c/s.

Write for Complete Information

GENERAL RADIO COMPANY
WEST CONCORD, MASSACHUSETTS

Sole New Zealand representatives:–

W. & K. McLEAN LTD.

P.O. BOX 3097, AUCKLAND. TELEPHONE 34-541
PRIVATE BAG LOWER HUTT TELEPHONE 699-864

We maintain our own servicing and calibration laboratory in our Lower Hutt Office, 437 Hutt Road, Lower Hutt

ENQUIRY CARD AD. 5

COLD
LOGIC
When the problem is the lowering of temperature, it's a matter of cold logic to use 'ARCTON' chlorofluorohydrocarbon refrigerants from I.C.I. They're of consistent high quality and low moisture content; and they're non-toxic, non-corrosive and non-inflammable.
You'll find a refrigerant ideally suited to your particular needs in the wide 'ARCTON' range.
If you would like detailed information on 'ARCTON' Refrigerants and their application, write to I.C.I. (N.Z.) Ltd.
'ARCTON'
REFRIGERANTS

N.Z. Stockists:
Electric Refrigeration N.Z. Ltd., 210-214 Lambton Quay, Wellington.
Ellis Hardie Symington Ltd., Fanshawe St., Auckland.
Ellis Hardie Symington Ltd., Thorndon Quay, Wellington.
Ellis Hardie Symington Ltd., P.O. Box 1569, Christchurch.
Frigidaire Div. of General Motors N.Z. Ltd., P.O. Box 795, Wellington.
A. W. McDonald Ltd., 5-7 Weld Street, Auckland.
Allan Newbold & Co. Ltd., Thorndon Quay, Wellington.
G. E. Patton Ltd., P.O. Box 92, Christchurch.
N. O. Pierson Ltd., 27a Southwark St., Christchurch.
Refrigeration Engineering Co. Ltd., P.O. Box 12072, Auckland, S.E.6.
Refrigeration & Heating Engineers Ltd., P.O. Box 976, Dunedin.
Seal Unit Service Ltd., Holland Street, Wellington.
H. Simpson Ltd., P.O. Box 583, Christchurch.
Simpson-Kane Refrigeration Ltd., 86 Vivian Street, Wellington.
Spicers Home Appliance Centre Ltd., 93 Bridge Street, Nelson.
and from a New Zealand-wide network of authorised Frigidaire Dealers.

ICI

IMPERIAL CHEMICAL INDUSTRIES (N.Z.) LTD.

P.O. Box 900 AUCKLAND
P.O. Box 1592 WELLINGTON
P.O. Box 1486 CHRISTCHURCH

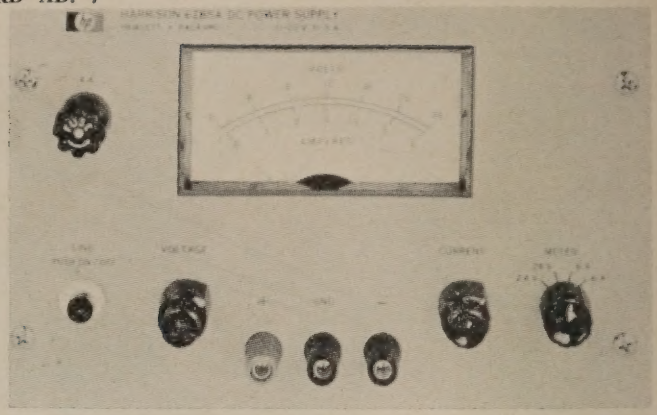
GC/2676/64

ENQUIRY CARD AD. 7

NEW laboratory and bench DC. power supplies from

HEWLETT PACKARD

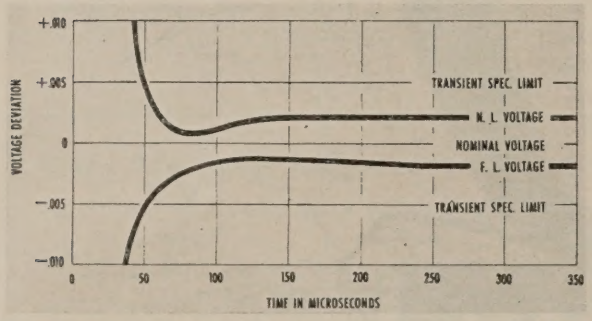
HARRISON DIVISION



★ Output ratings — all silicon circuitry ★ Constant voltage — constant current with automatic crossover ★ Remote programming and sensing ★ Half rack width — easily rack mounted ★ Multiple range meter ★ Overvoltage protection "crowbar" option.

VOLTS	AMPS	MODEL
0 - 7.5	0 - 5	6281A
0 - 10	0 - 10	6282A
0 - 20	0 - 3	6284A
0 - 20	0 - 5	6285A
0 - 20	0 - 10	6286A
0 - 40	0 - 1.5	6289A
0 - 40	0 - 3	6290A
0 - 40	0 - 5	6291A
0 - 60	0 - 1	6294A
0 - 60	0 - 3	6296A
0 - 100	0 - 0.75	6299A

Shore Circuit Proof — The supply will withstand any overload, including a direct short circuit across the output terminals, for any time interval without damage. **Constant Voltage/Constant current operation with automatic crossover.** 1. Continuously variable current limiting in constant voltage operation. 2. Continuously variable voltage limiting in constant current operation. 3. No external resistors or restrapping required in order to convert between constant voltage and constant current operation. **Floating output** — supply can be operated as a positive or negative source. **Front and Rear output terminals with automatic error sensing** — The supply automatically regulates with respect to either the front or the rear terminals according to which terminals are connected to the load — no switching or restrapping required in order to achieve the best possible regulation at the desired pair of output terminals. However, because of the resistance of the front panel terminals, optimum load regulation performance is obtained at the rear terminals for load current in excess of 3 amperes. **Remote Programming** of output voltage and current using input resistance, voltage, or current. **Rack Mounting Hardware** permits easy rack installation of power supplies either singly or in pairs. **Full output rating to 50°C** — can be operated to 71°C, consult us for derating information. **Auto-Tracking** — Two or more supplies can be controlled from the "master" unit, with the resulting output voltage of these supplies remaining proportional at all settings. **Transient Recovery Time:** Less than 50μ seconds is required for output voltage recovery in constant voltage operation to within 15 millivolts of the nominal output voltage following a change in output current equal to the current rating of the supply or 5 amperes, whichever is smaller. The nominal output voltage is defined as the mean between the no load and full load voltages. See typical Transient Recovery Chart below, left !



TYPICAL SPECIFICATIONS: MODEL 6284A

Output D.C. voltage = 0-20V, D.C. Current = 0-3A, **Input** 210-250 VAC, 50-400 cps; **Load regulation Constant Voltage** = 0.01% plus 4mV. **Constant Current** = 0.01% plus 250 μa; **Line Regulation** C.V. = 0.01% plus 2 mv: CC = 0.01% 250 μa; **Ripple and noise** C.V. = 200 μV RMS, CC = 2 ma RMS; **Temperature coefficient** C.V. = 0.02% plus 500μV; CC = 0.02% plus 1.5 ma. **Stability CV** = 0.1% plus 2.5 mv cc = 0.1% plus 7.5 ma; **Remote programming C.V.** = 200 ohms per volt **C.C.** = 500 ohms per amp. **Meter ranges** 0-2.4V, 0-24V, 0.4A, 0-4A. **Price £110/5/-.**

The prices of these units range from £110/5/0 to £207/7/6

Other Laboratory and system dc power supplies also available

Write to Sample Electronics for full details of these compact, versatile instruments.

VOLTAGE OUT	CURRENT OUT	LAB MODEL	SYSTEMS MODEL
0-10v	0-100A	6260A	—
0-18v	0-10A	6263A	6363A
0-18v	0-20A	6264A	6364A
0-36v	0-3A	6265A	6365A
0-36v	0-5A	6266A	6366A
0-36v	0-10A	6267A	6367A
0-40v	0-30A	6268A	—
0-40v	0-50A	6269A	—
0-60v	0-3A	6271A	6371A
0-60v	0-15A	6274A	—

N.B. All prices shown are duty paid delivered anywhere in New Zealand

S SAMPLE ELECTRONICS (N.Z.) LTD.

8 Matipo St., Onehunga, Auck., S.E.5., Phone:- 567-356

HEWLETT hp PACKARD

An extra measure of quality

SERVICE AND CALIBRATION FACILITIES PROVIDED. SPARE PARTS ALWAYS AVAILABLE

Radio, Electronics and Communications

Formerly Radio and Electrical Review
(Established 1946)

CONSULTANT EDITORS:
C. W. Salmon, M.N.Z.I.E., Grad. I.E.E., Assoc. I.E.R.E.
I. H. Spackman, A.M.I.E.E.E.
P. L. Watts representing N.Z. Electronics Institute

EXECUTIVE EDITOR:
Robin H. E. Beckett.

* * *

Published Monthly by the Proprietors:
THE MAGAZINE PRESS LTD.,
Publishers also of
HOME AND BUILDING
at the Registered office of the company, Employers Association Building, 157 Khyber Pass, Auckland, C.3, N.Z. P.O. Box 1365, Auckland. Telephone 41-508, 41-519.

Director and Chairman:
Victor L. Beckett
A.A.I.(Aust.) Hon.A.N.Z.I.A.

Director and Secretary:
Wilma W. Beckett

Production Manager:
Robin H. E. Beckett, B.A.

OFFICIAL JOURNAL OF
The New Zealand Electronics Institute (Inc.)
Secretary: J. L. McKie, P.O. Box 1506, Christchurch.

* * *

Sole New Zealand Distributors:
GORDON & GOTCH (N.Z.) LTD.

From Newsagents — 2/6 per copy. Or direct from the publishers 30/- per year in advance, post free throughout the world.

* * *

Advertising Representatives for the United Kingdom.
PUBLISHING & DISTRIBUTING CO., LTD.,
177 Regent St., London, W.1.

* * *

Printed by Farrell Printing Ltd., Mt. Roskill, Auckland. Registered as a newspaper at the G.P.O., Wellington.

Vol. 21, No. 2 April 1, 1966

CONTENTS

☆

Page

Editorial . . .

How to be prominent 11

An Amplifier using BCY42 Transistors 12

Commonwealth Ties in N.E.R.C. project 13

What is a Spectrum Analyser 16

Autocrat — Models TRM-3, TRP-3 — Circuit & Service Data 20

Europe's First Micro-Computer 25

Trade Notes 28

A new look at Diode Modulators 30

Radio Canada — Essay competition 31

Electronic Telephone Exchange using Reed Relays 37

☆

Departments . . .

Letters 7

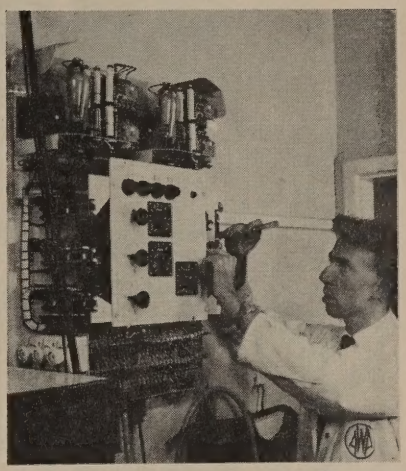
Serviceman's Column 24
by J. Whitley Stokes

Listening Post 29
by Michael Lawrence

Book Reviews 33

New Products 35

On Our Cover



Our front cover this month shows an AWA X-Ray engineer installing a Programme Selector at Christchurch Hospital. This particular equipment is used to programme the rapid sequence of radiographs which are necessary in the field of Angiocardiography, a technique whereby X-Ray opaque contract media is introduced into an artery. The progress of the dye is followed, by a programmed series of X-Ray pictures, through the valves and chambers of the heart. In this way defects in the operation of the valves or walls of the heart chambers can be identified by the Radiologist. The Programme Selector ensures that the radiographs are taken at the correct time and phase of the flow of the opaque media through the heart and at a speed which will be rapid enough to ensure that no aspect of the heart under examination is overlooked. The initial period, immediately after the injection of the contrast media, is the critical one as the flow of the media through the valves and into the chambers of the heart occurs in a very short time. This necessitates the radiographs being taken at a rate of up to 6 or sometimes even 12 per second.

Such examinations as the one described above, with the knowledge and skill of the present day surgeon, have made possible open heart surgery. These operations, of course, enable heart defects to be corrected. Associated with such work is a mass of electronic equipment such as Cardiac Monitors, Pacemakers, Defibrillators, to name just a few.

Coming . . .

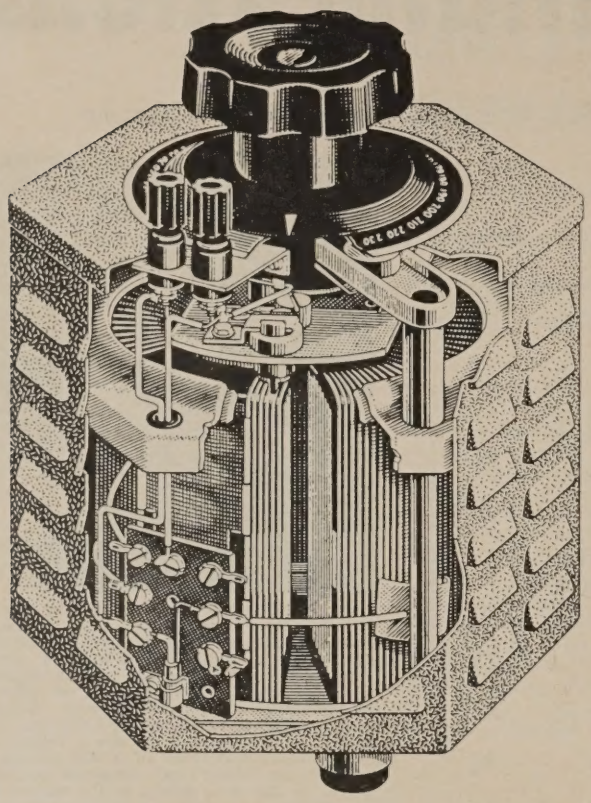
Spectrum Analysers — conclusion
V.L.F. Research — Part III
432 Meg Transmitter
Closed Circuit TV project
Wideband Pre-Amplifier
N.E.R.C. — Draft Constitution
Electronics in Action — further details of papers
TV Kitset

Also . . .

Circuit & Service Data
Listening Post & Australian DK Club
Serviceman's Column
New Products
Book Reviews
Camera View
Readership Survey

ENQUIRY CARD AD. 10

PHILIPS *Variable transformers*



Philips variable transformers are designed and manufactured with such care that they will give reliable service over a long period of life. They are available mounted in a durable, attractive case or without the case for panel mounting.

★ Can be mechanically coupled for series, parallel or 3-phase (star connected) operation.

★ Accurate and uninterrupted regulation.

★ Individual units rated up to 2 kVA.

★ Low weight, small dimensions.

★ Continuously variable from zero to 20% above input voltage.

★ Highly efficient due to extremely low "no-load" losses.

★ Toroidally wound.

★ Low cost.

★ Suitable for ganging and combining.

★ **All models available ex stock.**

IMPORTANT!

Recently released overseas and an ESSENTIAL for all TV service work is the new Philips double-wound ISOLATING variable transformer. These transformers have a power rating of 350 watts which is more than sufficient for all TV service work. They are available for bench mounting complete with fusing and voltmeter, or for panel mounting. Further particulars on request. Limited stocks only are available.

Write or telephone today for further particulars
Illustrated catalogue available.

EDAC

ELECTRONIC DEVELOPMENT AND APPLICATIONS CO. LTD.

P.O. Box 6415, Telephone 54-039, WELLINGTON.

P.O. Box 9338, Telephone 545-082, 548-576, AUCKLAND.

Letters from Readers

Sir,

Some time ago there was a series of constructional articles in your magazine for utilizing the VCR 97 cathode ray tube in a six inch television set; I should be very grateful if you would let me know which copies these articles were in and if they are procurable now and also the price of same.

Enclosed please find a stamped addressed envelope for reply.

Thanking you in anticipation,

D. G. PARKER,
Dannevirke

Further to your enquiry we are pleased to advise that the issues concerned were:

November, 1964
January, 1965
February, 1965
March, 1965

These issues are available at 2/6d. each. We await your advice concerning the despatch of these copies.

Thanking you for your enquiry.

—Ed.

Sir,

In "Radio, Electronics and Communications" (then "Radio & Electrical Review") 1st December 1963, there was an article on the "R. & E." Adaptoscope. I did not start getting this magazine till then and missed out on previous articles on the Adaptoscope. In the Brilliance circuit of the 4 GPI C.R.T. there is an 80V neon-diode. What is the purpose of this diode? Would the Brill. control be linear with this?

A. ROXBURGH,
Johnsonville, Wgtn.

Further to your recent letter we would advise that the neon-diode referred to is included to voltage stabilize this section of the circuit keeping the relative voltages constant and so preventing excessive swings.

Should you require the further issues containing information on the R. & E. Adaptoscope we have limited stocks available and would be happy to forward these to you if you would advise accordingly.

—Ed.

N.Z. WINNERS OF U.K. ELECTRICAL SCHOLARSHIPS

Each year approximately £20,000 in scholarships are awarded by various British Electrical concerns, and the results of the latest awards have just been released. Each scholarship is valued at around £2,000 and includes the return fare to England plus a generous salary during the two year training period.

Awarded by Associated Electrical Industries (N.Z.) Limited

F. G. B. Furkert
(B. E. Electrical) of Auckland to study Electronics

J. S. Goldsbury
(B. E. Electrical) of Auckland to study Industrial and Electronic Applications

Awarded by English Electric Company of N.Z. Limited

Nigel McLean Hayton
(B. E. Honours Electrical) of New Plymouth to study Industrial Systems and Automation — Electronics

Michael Bernard Dewe
(B.Sc. Eng. M.E.) of Christchurch to study Industrial Systems and Automation — Design and Research

Awarded by A. Reyrolle and Company Limited

D. A. Winthrop
(B.E.) of Porirua to study Distribution and Control of Electrical Energy

R. G. White
(B. E.) of Upper Hutt to study Distribution and Control of Electrical Energy

B. J. V. Dunn
(B.E.) of Christchurch to study Distribution and Control of Electrical Energy

Awarded by General Electrical Company Limited

N. R. Nicholls
(B E.) of Christchurch to study Tele-communications

FIRST NEW ZEALAND ELECTRONICS CONFERENCE

Next month we will publish a provisional list of papers accepted in these seven sections of the Conference:

Data Handling

Modern Communications

Research Electronics

Industrial Electronics

Medical and Biological Electronics

Electronics in Aviation

Nucleonics

Electronics Education

For further information write

The Secretary,
P.O. Box 3325,
Auckland, C.1.

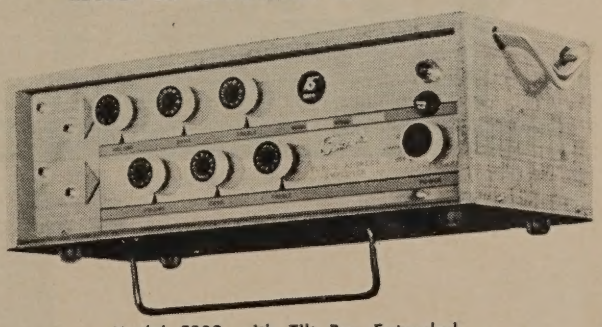
Venue: University of Auckland; Date: August 17th-20th, 1966

ENQUIRY CARD AD. 24

concord ELECTRONICS

CE

this is concord



Model 5303 with Tilt Bar Extended

CONCORD PUBLIC ADDRESS AMPLIFIER

Adaptable to all systems this 15 watt R.M.S. Concord P.A. amplifier has power and frequency response well above usual P.A. limits. Many extras are built-in "standards" with this Concord amplifier that meets the rigid standards of reliability, purity of sound and stability of all models in the Concord range.

Also available with 35 watt output.

concord
ELECTRONICS LTD
P.O. BOX 36001., NORTHCOTE, AUCKLAND, PH.285-825

ENQUIRY CARD AD. 12

SQ *Special Quality tubes for industrial equipment*

Latest frame-grid technique betters HF performance

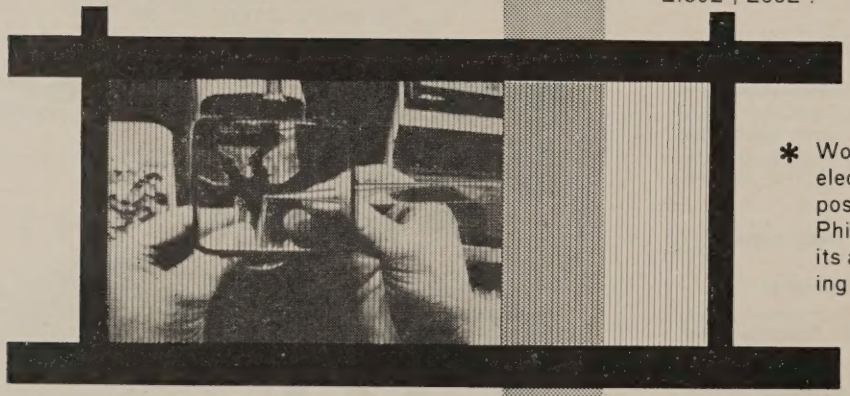
The use of electron tubes in industry is expanding from day to day. New applications and improvements in existing applications more than ever require utmost reliability. Therefore Philips developed the Special Quality series.

In the field of HF-applications, favourable characteristics are also of great importance. Philips therefore elaborated and perfected the frame-grid technique (more windings with only 10, 8 or even 5 micron thin wire!), realising:

- higher mutual conductance
- less microphony
- smaller spread in characteristics
- life-long stability

The application of the frame-grid technique in SQ-tubes realises a valuable series of tubes for almost any industrial HF application:
E88CC, E188CC, E180F, E186F, E810F*, E130L*, E55L*.

*dual frame-grid



Assembling the tube systems in precision jigs

✱ Worldwide know-how of electronics at your disposal. Contact the Philips organisation for its application engineering service.

	max. anode dissipation W	anode voltage V	anode current mA	amplification factor	mutual conductance mA/V
E88CC(6922)	1.65	100	15	33	12.5
E188CC(7308)	1.65	100	15	33	12.5
E180F(6688)	3	190	13	50	16.5
E186F(7737)	3	190	13	53	16.5
E810F(7788)	5	135	35	57	50
E130L(7534)	27.5	250	100	6.5	25
E55L	10	140	50	30	45

PHILIPS

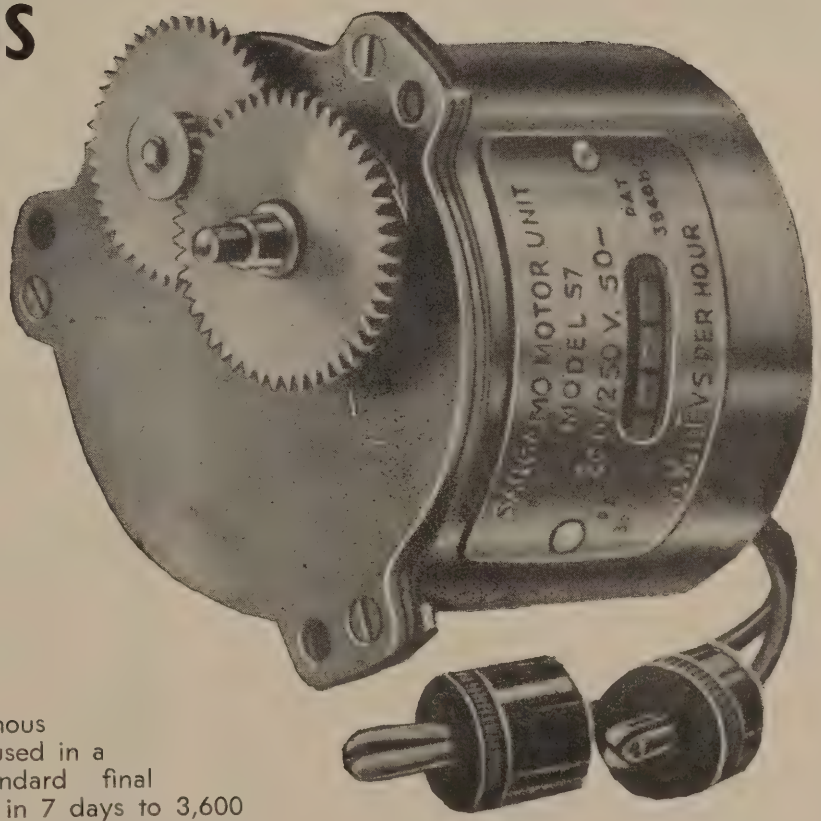
PHILIPS **MINIWATT**

NUCLEUS OF INDUSTRIAL ELECTRONICS

ENQUIRY CARD AD. 13

sangamo

SYNCHRONOUS MOTOR and CLOCK UNITS



The SANGAMO S7 motor unit consists of a self-starting synchronous motor driving a train of gears housed in a sealed dust-proof housing. Standard final spindle speeds range from 1 rev. in 7 days to 3,600 revs. per hour. The ideal unit for frequency controlled timing mechanisms such as electric clocks, time switches, chart drives, and any light mechanism requiring a definite time interval.

● *All speeds available for immediate delivery from stock*

E. C. GOUGH LTD.

BOX 873 — PHONE 62-254 — CHRISTCHURCH
BOX 8150 NEWTON — PHONE 16-100 — AUCKLAND

ENQUIRY CARD AD. 14

ROHDE & SCHWARZ

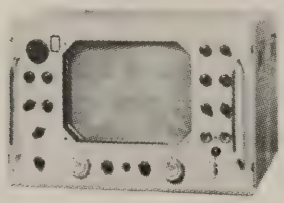
AND

SCHOMANDL

Precision test equipment covering all classes of:–

Standard Time Systems
Instrument Test Equipment
Data Processing Equipment

NOW! measure up to 1200mc.



Polyskop Type SWOB

A wide band two channel frequency response display for two and four terminal network measurements. Polyskop I 0.5 to 400 MC. Polyskop II 0.5 to 1200 MC.

SCHOMANDL

Transistorised Frequency Synthesizers up to 1200mc. Service Frequency meters etc.

The model illustrated at right is the FD1, an extremely high accuracy frequency meter measuring up to 900 Mcs equipped with a crystal generator, particularly suitable for servicing of mobile radio etc.

Sole N.Z. Agents:

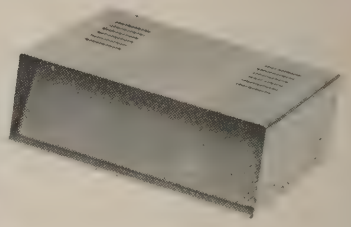
ELEKON (OVERSEAS) LTD.

PHONE 16-189 OR WRITE P.O. BOX 5146, AUCKLAND

Also sole agents for Motorola Semiconductors and Beckman Digidial Counters.

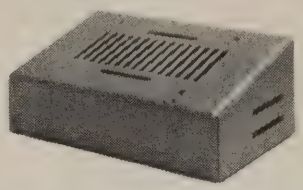
ENQUIRY CARD AD. 22

CABINETS



Designed for the stereo amplifier system as appeared in the September issue of R. E. & C.

Suitable for any amplifier 9¾" long x 7" deep x 3½" high



Speaker enclosure originally designed for the RE & C Transistercom, but perfectly suitable for speaker housing requirements. Can be wall or desk mounted. 6" wide x 3½ deep and 1⅞ high at mid-point.

We stock a complete range of chassis, speaker enclosures etc. and will advise you on the correct size for your application. All your components held in stock and we mail anywhere.

RADIO TRADERS LTD.

For all Your Chassis, Components, Transformers, etc.

243 HOBSON STR., AUCKLAND. P.O. BOX 2619. PH. 24-774

Trade Enquiries to: **R. P. STUBBING LTD.**
P.O. BOX 2619, PH. 24-774
TELEGRAMS "RADTRAD" AUCKLAND

ENQUIRY CARD AD. 23

How To Be Prominent

A great many people in electronics and radio spend a lifetime in the industry without achieving any outstanding recognition. In New Zealand this often leads to charges that those in possession tend to form self-perpetuating associations. Recently we came across an article in an American publication, The Journal of Occupational Medicine, which deals with just this very problem and they, in their editorial, point out that there are standard rules which govern such situations and then enumerate some requirements which we list below with necessary amendments that would apply to our own industry.

1. Become active and serve in your own society or institute. Seek and earn office at local level which will provide experience that will prove helpful when seeking a place in the national body.

2. Let it be known at national headquarters that you want to work and will undertake any assignment. Usually this leads to appointment to some committee and that leads to the first rung in the ascending ladder.

3. Attend annual meetings. Although this is by no means a guarantee of recognition as worthy of higher service, it is a requisite.

4. Participate in the meetings of both the national and local body either by appearing on the programme or at least in discussions. Many of the meetings at the national assembly are open to the membership, and aspiring members should be seen at as many of these meetings as possible. For example, there is annually a meeting of the component societies at which all members are welcome. Attend, participate, and if it is warranted, even protest.

5. Write papers or articles of such quality as to deserve publication. This should not necessarily be highly technical or the product of a research laboratory. Every technician, scientist or engineer has within his own facilities material worthy of publication if properly selected and suitably organised. The two institutes in New Zealand, The Institution of Electronic and Radio Engineers and the N.Z. Electronics Institute, are continually searching for material, as is, also, this journal.

6. Devise and espouse your own particular cause. People the world over who get anywhere have a cause. Promote it not with the idea of exploiting it but in the hope of making a contribution which deserves attention.

7. Seek to join and participate in the affairs of scientific and technical organisations in the radio and electronic field. Every eligible person should seek either to become a member of the Institution of Electronic and Radio Engineers or the N.Z. Electronics Institute. Prominence in either of these organisations will pave the way towards prominence in the industry.

8. Seek and deserve friendship among those outstanding in the industry. This is not self-seeking; it is simply that your name may come to the mind of those in authority when new hands and new abilities are needed.

9. In due course the aspiring member may be nominated for office. Nomination is by no means the end — what it means is, of course, the eventual allocation to an office, whether to an institution or to a trade association. After the nomination it will be necessary to seek the support of those who are at hand either in your own local branch of the association or institution or those merely near you geographically because it is these people who are most familiar with your abilities. Without doubt there are politics in all bodies and it is these politics, even at a local level, that determine election.

Observance of all these rules is no guarantee of advancement but regardless of this, two things are of prime importance, i.e., genuine ability and hard work but it is hard work that counts most and is the reason for the prominence of many already in high places in the industry.

An Amplifier Using BCY42 Transistors

Now available freely from the makers* is a general purpose silicon epitaxial n.p.n. transistor of planar construction having good low noise performance. This is the BCY42 and this short article describes its use in a simple two transistor circuit having a voltage gain of 200 with the input and output loadings shown in the circuit.

Such a configuration is suitable as the basis for a pre-amplifier as the gain is sufficient for tone controls to be incorporated. Alternatively, the circuit may be used as an amplifier for 100 output devices such as magnetic pickups.

The BCY42 is described as a general purpose amplifier transistor and circuitry is available for its use up to 10 Mc/s as a wide band amplifier and this application will be described at a later date in this journal. The characteristics given by the makers are as follows:—

Common emitter gain — frequency product = 100 Mc/s
Common base output capacity = 6pF
(V_{CB} = 6V I_E = 0)
Narrow Band noise figure = 10dB
Common emitter forward current transfer ratio hfe
Ic 1mA, V_{CE} 5v; 45
Ic 50mA, V_{CE} .5v; 23
Ic 100μA, V_{CE} 5v; 23
V_{CE} saturation at Ic 10mM and I_B 1mA = .25v
V_{BE} saturation at Ic 10mA and I_B 1mA = .85v

Absolute ratings

Collector dissipation in free air at 25°C = 300mW
V_{CB} max 40v
(emitter open circuited)
V_{CE} max 25v
(base open circuited)
V_{EB} max 5v
(collector open circuited)
Ic mean 100mA
Ic peak 200mA
(less than 100 μsec)
I_B mean 10mA
I_B peak 20mA
(less than 100 μsec)
Maximum junction temperature 175°C

Outline

VASCA; SO12A
JEDEC; TO-18

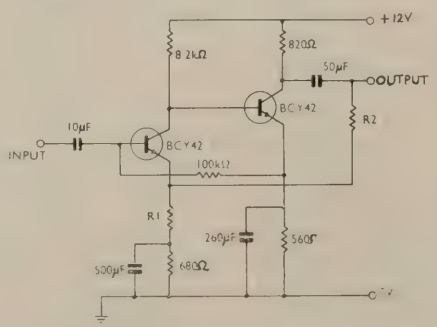
Base connections

From underside with lug at —45° clockwise: emitter, base, collector n.p.n. with collector connected to the case.

The transistor may be mounted in any position and a heat sink is not required in the circuit under consideration.

The Circuit

This amplifier is designed to operate from a 12 volt supply to deliver 1 milliwatts into a 600 ohm load and operates over a temperature range 0°C to 55°C. The BCY42, having a 2:1 spread in current gain can be designed into a circuit using ordinary tolerance components. This same tolerance of ± 10% applies to the supply voltage and load termination so that there are no critical considerations.



In this circuit the BCY42's have been used purely as an audio amplifier but there is no fall off of gain at 100 kc/s despite the 1000 pF capacitor used to eliminate the H.F. instability in the breadboard prototype.

This amplifier was built as part of a minor investigation into suitable transistor types for low noise amplifiers in measuring circuits and as non-critical construction was required no special techniques were used and the broadboard construction used was laid out almost in the fashion of the circuit diagram on a small piece of bakelite.

The test results were as shown below:—

Frequency response ± 1dB 40c/s — 100 Kc/s
Voltage gain 200
Current gain 3700
Power gain approx 60dB
Input voltage for 1mW 2.7mV
Harmonic distortion .52% at 1 Kc/s
† Open circuited input impedance 8 K ohms
Output impedance, with 600 ohm load, 110 ohm

Slight H.F. oscillation was noted on a cathode ray oscilloscope, being at about 800 Kc/s. This was cured by the addition of a 1000 pF capacitor from the collector of the first BCY42 to ground. Whilst this will undoubtedly affect the frequency response above 100 Kc/s it will present no problem at audio frequencies.

Properly designed layout should result in performance up to 1.5 Mc/s for 3dB response down to 20 c/s.

† The results above were measured with a 1.5 K ohm resistive load across the input terminals.

* Standard Telephones & Cables Ltd., through S.T. & C., N.Z., Box 40-140 Upper Hutt.

Have *You* Enrolled?

National Electronics Conference

AUCKLAND
AUGUST 17 - 20

Commonwealth Ties For N.E.R.C.

Our March issue carried, as its editorial, comment on the visit of Mr. Graham Clifford to New Zealand and in this was an initial indication that there was to be set up in New Zealand a National Electronics Research Council. Since then further information has come to hand regarding the N.E.R.C. in Great Britain and we take this opportunity of reviewing its work in Britain and commenting upon its future in this country.

Under the guiding hand of Lord Mountbatten, the N.E.R.C. was incorporated in Great Britain in July of 1964 and in the first publication of N.E.R.C. he outlined some of the reasons for the setting up of such a council. It was formed, he said, in order to help understanding between all who are concerned and engaged in electronics research. Lord Mountbatten wrote that there has been continual improvement in visual and audio communication between people but paradoxically very little has been done to improve communication between research workers and those responsible for financing and directing their efforts. The interchange of information between research workers is the first step in a co-ordination of effort towards reducing duplication of research projects so that the available finance can be directed towards useful ends rather than wasted on two, or even more, almost similar projects.

About the same time that the N.E.R.C. was formed in Great Britain, New Zealand's own National Research Advisory Council was set up, this body being concerned mainly with general research effort in government and government assisted bodies and already valuable impetus has been given to agricultural research in New Zealand by our own Research Advisory Council. However, whilst it was not clear at the time of setting up of the New Zealand Research Advisory Council what would be done in the electronic field, recent discussions have shown that there was no intent to investigate electronics as a particular branch of research. Because of this the establishment of an N.E.R.C. in New Zealand will not cut across our own National Research Advisory Council but will do much to assist it.

In Britain the N.E.R.C. has a very wide field of interest in that there are over a score of universities actively engaged in electronics research and as many large companies similarly engaged. On the other hand, in New Zealand, there is a wider number of small agencies using or hoping to use electronics as a research and development tool and there have already been instances of government departments working "In Vacuo" on almost similar problems, and this was highlighted at the last Science Congress held in Auckland.

The establishment of a liaison programme between universities, government departments and industry takes some time but N.E.R.C. in Britain became aware at an early date that printed information was just as much of a problem as research co-ordination and for many years Lord Mountbatten has expressed concern at the "information explosion". In the field of electronics alone in 1964 there were over 26,000 papers and documents published and in the whole scientific field there are over a million scientific papers being published each year in about 20,000 periodicals.

Obviously it is just beyond the possibility of anyone to even scan this quantity and retain information. Because of this, one of the first jobs tackled by the N.E.R.C. in Britain was a proposal to investigate Selective Dissemination of Information (S.D.I.). A working party was set up to establish the extent of the problem and to find methods for its solution.

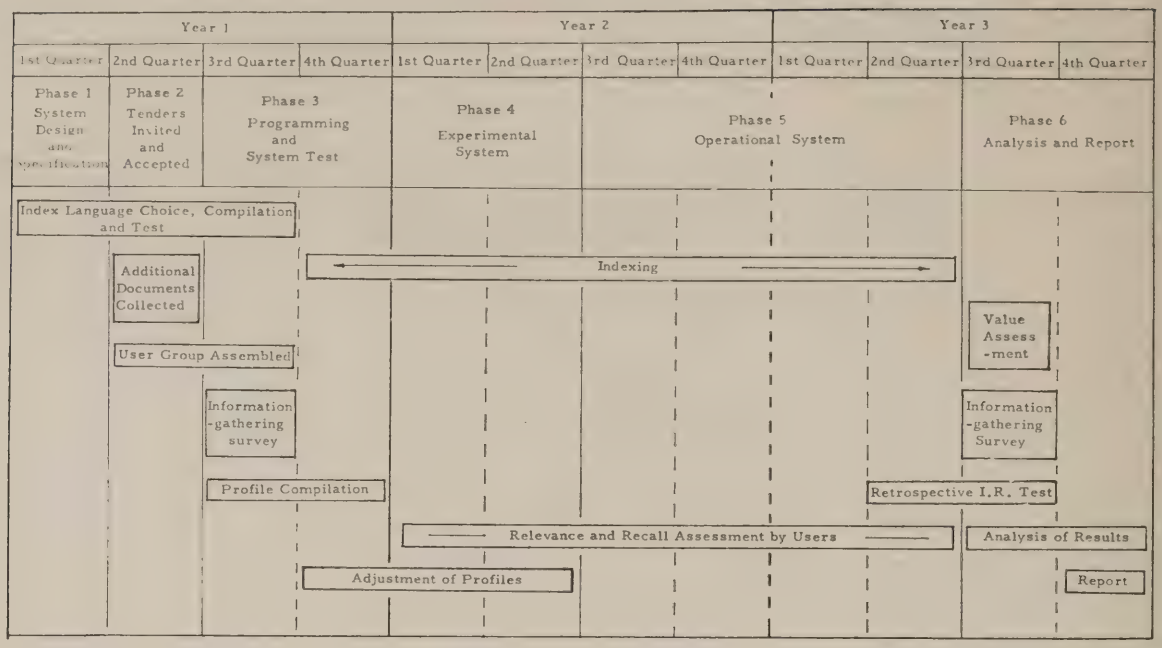
A most interesting outcome of this was that they found that a worker who wished to know all that appeared in his own field might have to search each month more than 10 abstracting journals and title lists to select those items of interest to him. He would then have to obtain the actual journals mentioned in the abstracts and read the articles. It was not said how many actual journals this would involve but our own knowledge of the subject, in New Zealand, would indicate this could certainly be twenty or thirty a month.

This British investigation eventually recommended, in October, 1964, that a system of S.D.I. in the electronics field should be set up. S.D.I. is basically a method of providing on quite a large scale an information service to individuals or groups on a personal basis. Of course, this type of system has been used for a number of years by libraries or information services which have particular knowledge of the needs of people under their care. For instance, libraries of government departments and universities, but here there has always been a close and personal relationship with the users and a knowledge of their day to day necessities and this method is only suited for a fairly small number of users.

However, this personal contact can be transferred to computer methods and it is this system that S.D.I. will employ. Because the system will be computerised there is, in fact, no limit to the number of associations that can use it or to the number of incoming journals that can be scanned and it is here that the New Zealand N.E.R.C. will be immediately able to join in with the British one on a Commonwealth basis and, in fact, there will be Australian, Indian and Canadian counterparts. These are at the moment being formed concurrently with our own New Zealand body.

In the computer S.D.I. system each user provides details of his subject interests and these are translated into index terms called "User Profiles" and these profiles are then stored in a machine system. As documents — periodicals, articles, reports, conference papers — are received by the information service they are indexed by subject using the same vocabulary of terms and details of each document and the

PROGRAMME



terms used to index are transferred to a second machine file. At suitable intervals these two files, that of the user profile and that of the indexed document, are compared by computer. Where there is sufficiently close match between these two the details of a document are printed out and sent to the user.

An important element in the whole system is the provision for "Feed back", whereby the user is asked to assess the material he receives against his need and also his whole knowledge of what he sees published relevant to his work. In this way he is able to alter the information to receive either a more restricted or a wider information service. For interest of our readers, and to illustrate how documentation and computer systems can be used in such a scheme, we reprint two diagrams which appeared in the N.E.R.C. Review in January, 1965. Phases one and two have just been completed and also a trial information service has been carried out in England to assess the overall idea. Although tested with a relatively small number of workers, it has been proved feasible.

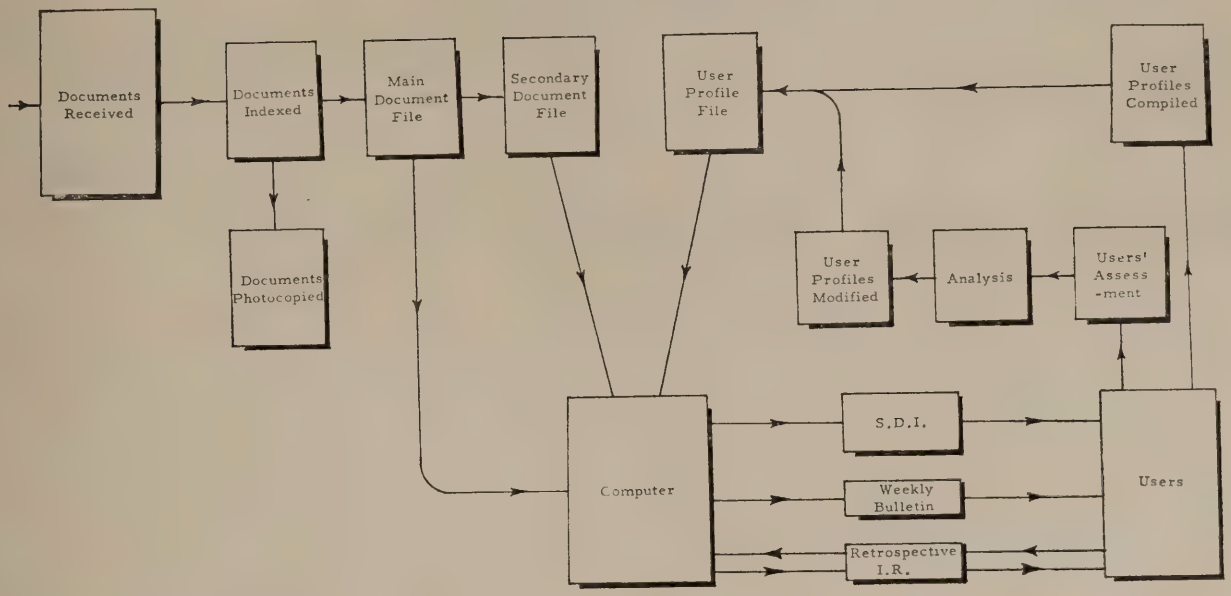
Whilst there is no denying that the whole scale of electronic operations in New Zealand is on a very much smaller scale than even, say, in Australia, the problems are basically the same and in New Zealand we feel they are somewhat aggravated by the fact that we have only limited import-export finance so that our research and development effort must be used to maximum advantage. The example of "directed" research effort in Great Britain illustrates how N.E.R.C. could operate in this country.

The fishing industry operating in the North Sea has, for a number of years, been concerned with the dwindling supplies of white fish and because of this the statutory body, The White Fish Authority, approached N.E.R.C. to enquire whether electronics could offer a means of investigating the habits and location of fish in the North Sea. After several discussions a research programme was worked out and the Authority advised of makers of suitable equipment or companies who could develop special equipment. Similar problems exist in New Zealand that could be presented to the New Zealand N.E.R.C. and also as the British body has now a direct link with the Medical Research Council a similar liaison could be useful here.

The examination of any research or development work by a body such as N.E.R.C. should widen the interest of the local electronics industry and increase the possibility of manufacture both of "one-offs" and production runs. Already several government departments are seeking competent manufacturers of equipment initially developed by them. For this reason the National Electronics Research Council's impact will extend appreciably beyond pure and applied research into the development and manufacturing sections of the industry. Perhaps we should say here that the whole concept of N.E.R.C. could be adapted in New Zealand to include development as an allied field to research as there are many fields in electronics in this country where application is the most important thing. Because of this the functioning of a New Zealand N.E.R.C. body may take slightly different lines from N.E.R.C. in Great Britain in that there is in New Zealand, we feel, more need for applied research and development techniques.

One of the other important aspects of N.E.R.C. has been, in Great Britain, its publishing of a quarterly review of progress in electronics research. Five of these quarterly Reviews have now been published and apart from information regarding the actual work of the Council itself there have been news items indicating work done in British Universities and the various set-ups regarding their engineering and electronic laboratories. Mr. Clifford, when he was in New Zealand, said that he hoped

FLOW DIAGRAM



that each Commonwealth N.E.R.C. body would publish its own Review so that there would be a free and immediate interchange of information around the Commonwealth. We hope that as soon as the New Zealand body is incorporated there will be sufficient support from industry, government and the universities for a local publication to be issued at regular intervals.

Because the whole concept of N.E.R.C. in New Zealand is hardly more than a month old it is yet too early to say how it will be financed but interest shown by representatives from government departments would indicate that much of value can be extracted quite early so that there is reason to expect worthwhile financial support from government. For industry the immediate returns may be a little slower because there is little research done in industry at present but the capabilities already apparent and the many development projects which industry could tackle with financial profit should assist.

At the Wellington meeting, one of the two called to form the New Zealand N.E.R.C., a government representative pointed out that New Zealand's topography was similar to that of South East Asia rather than the rest of the Western world and our communication problems were similar to those in, say, Malaysia or Thailand. Because of this much of the work done in the development of search and rescue sets was applicable to South East Asia rather than America or Europe. To highlight this we would mention that a recent contract for search and rescue sets was awarded to New Zealand manufacturers in competition with overseas tenderers. New Zealand being a member of such a Commonwealth organisation would be able to inform other members of our capabilities and would automatically learn of their needs through an information request from an overseas council. This would be of direct use to the electronic industry and it is hoped that support for a National Electronics Research Council will come as readily from industry in New Zealand as it has overseas.

Automated Circuit Production

A machine that can make "masters" to produce thin film microcircuits automatically at high speed is now in operation in Britain. They are made from masters produced by engraving into films of metal bonded with a substrate — for instance, glass.

The machine, developed by Standard Telephones and Cables, is controlled by punched tape. It completely cuts out the most expensive part of producing the circuits — making detailed, large scale drawings — and is extremely accurate.

It is also cheap. The only comparable equipment, which uses a different cutting technique, costs more than twice as much.

Its control tapes are easily compiled from a sketch drawing made by the circuit designer on graph paper. They consist of a series of co-ordinates of positions on the diagram and instructions to start or stop engraving.

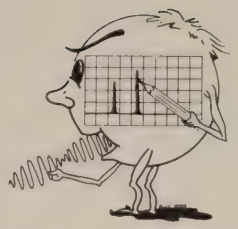
Tracks are cut into the metal by a stylus — really an electrode which discharges thousands of sparks per second to bore away the metal in a series of craters. The stylus is fixed and the workpiece is manoeuvred beneath it on a table which moves according to the taped instructions.

Tracks can be cut down to a width of two thousandths of an inch and an accuracy in position as fine as three tenths of a thousandth of an inch.

In addition, characteristics of a circuit can be measured while it is being cut, so they can be adjusted during the process. This means high accuracy in performance and reliability and creates the possibility of "tailor-made circuits".

Information for punching tapes can be sent by telex, allowing an engineer to programme a machine without going near it.

by Russ Myer*



What is a Spectrum Analyser?

Part One.
To be concluded next month

At any given moment, there is an incredible amount of activity within that portion of the electromagetic spectrum known as the Radio Frequency Bands. These bands range in frequency from about 15 kc to 750,000 Mc.

Assume you have a special radio receiver capable of tuning over this entire range. At the lower end, would be found maritime ship-to-shore, aircraft point-to-point, high-powered government and commercial transoceanic signals. Tuning higher in frequency, within the familiar 540-to-1600 kc broadcast band, dozens of commercial radio stations compete for attention. Above these, are found more ship-to-shore, and, confined to relatively small portions of the spectrum, thousands of "ham" radio operators pursue their electronic endeavours. Also, interspaced throughout this short-wave band, can be heard much air-ground activity, government point-to-point, many foreign broadcast stations, and some experimental work.

Still higher in frequency, are found television stations. The area above 400 Mc, once considered experimental, produces myriad signals: microwave, telemetry and others.

These radio transmissions take various electronic configurations, ranging from single-frequency carriers to complex signals produced by changing these carriers in amplitude, frequency and phase.

Regardless of the shape of these signals and how they were produced, or "modulated", each one can be separated into individual sine waves. Each sine wave represents a single frequency. To examine the composition and quality of a signal, it is very helpful to extract each individual sine wave that it contains and display it alone on an oscilloscope. Seeing all the sine waves in a "group" picture each standing alone, would enable analysis of the complex signal. The instrument that performs this task is called a spectrum analyser.

To use an example of a familiar but complex waveform which could be reduced to individual sine waves for analysis, consider an AM radio station. A broadcast transmitter radiates a single carrier frequency from its antenna. Intelligence (speech, music, tones, etc.) is superimposed on this carrier, varying its amplitude at an audio rate. Assume the station is transmitting a 1000-cycle test tone. The carrier frequency of the station is 1 Mc. This carrier is combined in the final stage of the transmitter with the 1000-cycle tone. The antenna, however, through the process of "modulation", is broadcasting not two, but three signals. Viewed on a conventional scope, the signal might look like figure 1a.

Electrically, the carrier is still occupying the 1-Mc spot in the spectrum. Exactly 1000 cycles below this frequency, however, at 999 kc, is a new signal, called the "lower sideband". 1000 cycles above the 1-Mc spot, at 1,001 kc, is another signal, identical to the one at 999 kc, called the "upper sideband". The separation is exactly equal to the modulating frequency — the 1000 cycle tone. The spectrum analyser is capable of displaying these three frequencies, individually, on the screen of a cathode-ray tube. Thus, the component frequencies may be individually studied, or "analysed". Figure 1b shows how the spectrum analyser would display them.

There is nothing difficult about the overall operation of the analyser. The signals which we will use as examples, however, must be followed in detail through the different sections shown in the block diagram. To understand the conversion of input signals to signals of lower frequencies, it is helpful to perform the simple arithmetical computations dealing with the mixer and i.f. (intermediate frequency) sections.

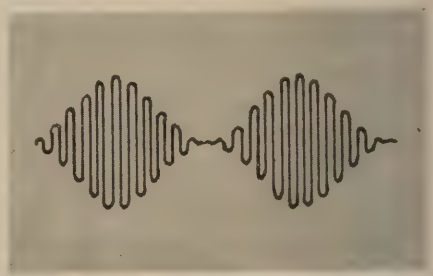


Figure 1a. Conventional oscilloscope display of 1000 kc carrier modulated by a 1000 cps tone.

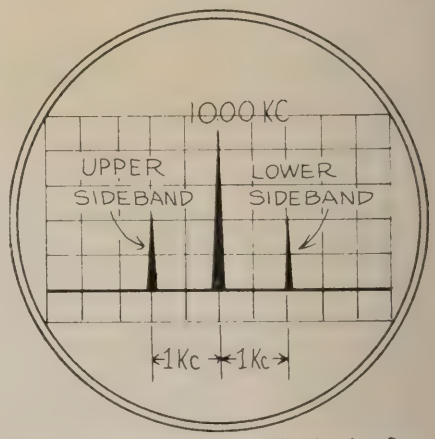
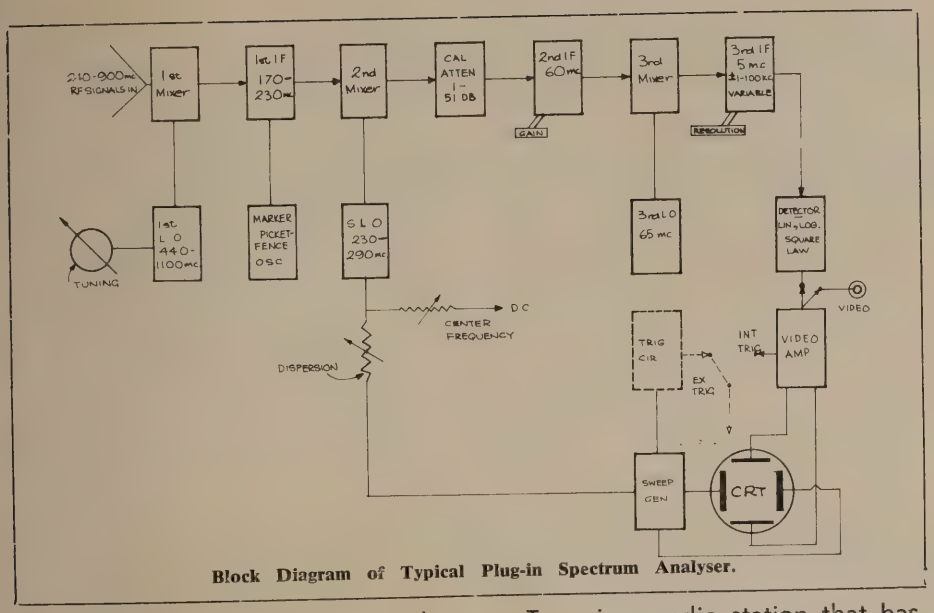


Figure 1b. Display of same signal using Spectrum Analyser.

There are several ways that a signal can be broken down into component sine waves. One method is to introduce the signal to a stack of filters, the inputs of which are paralleled. Each filter is tuned, in succession, to a slightly different frequency than the others. The output of each filter will contain only that portion of the input which corresponds to the frequency it was tuned to. The drawback here is

* Tektronix, Inc.



Block Diagram of Typical Plug-in Spectrum Analyser.

that for most complex signals, hundreds of filters would be needed — a costly mechanical burden. Too, it is difficult to design filters with narrow bandwidths to produce good resolution between closely-related signal components.

The prism is also a simple spectrum analyser. It takes the visible portion of the electromagnetic spectrum and breaks it up into its component frequencies, each representing a familiar colour. There are chemical analogies, also, such as the chemist's ability to reduce complex compounds into their individual ingredients.

HETERODYNING

To continue our discussion of the analyser, here is a brief review of the principle of heterodyning. Years ago, Armstrong and his colleagues created the "superhet" receiver. They discovered that it was possible to feed two separate single-frequency signals into a non-linear device, usually a vacuum tube, and get four signals out! Using suitable filters, they found that besides the two original frequencies, they had a third frequency that was equal to the mathematical difference of the input signals. Also, they found a fourth frequency in the output — one equal to the sum of the two original signals. They applied this principle to the well known superheterodyne receiver.

The following example illustrates this concept, so necessary to the understanding of spectrum analysers.

Tune in a radio station that has, say, a carrier frequency of 1080 kc. This frequency enters the front end of the radio and into a "mixer" tube. A local oscillator in the set, which follows the main tuning, generates a frequency of 1535 kc. This oscillator frequency also is fed into the mixer tube. In the output of this tube, as in the days of Armstrong, are the two original frequencies plus the two new frequencies mentioned before: 2615 kc and 455 kc. The latter, 455 kc, is the one accepted by the tuned circuits of the intermediate-frequency stages of the receiver.

In tuning across the band, a listener simultaneously tunes the local oscillator to a frequency exactly 455 kc above the frequency of the station tuned in. Thus, a highly efficient i.f. stage can be designed which is responsive to a signal frequency — the 455-kc difference between the local oscillator and the frequency present at the front end.

HOW THE ANALYSER WORKS

Tektronix spectrum analysers, built as plug-in accessories for existing oscilloscopes, cover various frequency ranges. Currently, these cover frequencies from 1 Mc to 10.4 Gc (Gigacycles). One of these, the Type L-20, will analyse frequencies from 10 Mc to 4 Gc, in 5 bands. The range of frequencies covered by band 2 of the Type L-20, roughly 230 Mc to 900 Mc is covered here.

Refer to the block diagram of the analyser. Incoming signals are introduced directly into the first mixer. As in the radio receiver, there is a local oscillator associated with the mixer. This oscillator is tuned by the front-panel control which also rotates the tuning dial indicating the frequency of the incoming signal. It tunes through a frequency range of 440 Mc to 1100 Mc. The output of the mixer is fed into the first i.f. stage. This stage is fixed-tuned to 200 Mc.

Therefore, any input signal that will mix with the local-oscillator frequency in the mixer stage and produce a difference frequency of 200 Mc will pass through the first i.f. For example, when the local oscillator (abbreviated L.O.) is tuned to its lowest frequency, 440 Mc (the main tuning dial reading 240 Mc), an input signal of 240 Mc will "beat" with this frequency in the mixer and produce the desired i.f. output of 200 Mc. Tuning the L.O. to 600 Mc means that there has to be an input signal of 400-Mc to produce a 200-Mc difference. The highest setting of the L.O., 1100 Mc, allows a signal of 900 Mc to produce the 200-Mc difference and appear in the first i.f. Any signal tuned in from 240 Mc to 1100 Mc will produce the same 200-Mc difference.

The first i.f. is tuned to a centre frequency of 200 Mc. The bandwidth of this circuit is fixed at 60 Mc. Therefore, any signals 30 Mc above or below the 200 Mc difference frequency will also pass through the i.f. This is important to the operation of the spectrum analyser.

We will now follow three input signals through the analyser. Their frequencies are: 280 Mc, 300 Mc, and 320 Mc. Assume the tuning dial has been set on 300 Mc, calling it the "Centre Frequency". Actually, the L.O. has been tuned to 500 Mc. This produces a 200-Mc difference between the L.O. and the 300-Mc centre frequency. This 200-Mc "beat" frequency falls in the middle of the i.f. tuned circuit. The input frequency of 280 Mc also is beating with the established L.O. frequency of 500 Mc. It produces an output from the mixer stage of 220 Mc. This falls within the 60 Mc bandpass of the i.f. stage. The input of 320-Mc also produces a frequency (180 Mc) that falls within the bandpass of the i.f. stage.

Therefore, at the output of the first i.f. stage, all three input signals are present. They have the same 20-Mc separation but are reduced in frequency. Although converted in frequency, their relationship to one another has not been changed. It is important to realize one difference, however: The 180-Mc i.f. signal represents the highest-frequency input signal, 320 Mc. The 220-Mc i.f. signal represents the lowest-frequency (280 Mc) input signal. In other words, there is a reversal of relative frequency.

The three signals at the output of the first i.f. stage are now fed into a second mixer. See block diagram. This mixer is also associated with a local oscillator, and the output is fed into a 2nd i.f. stage. This stage is actually tuned to 59 Mc, but to simplify the example, consider that it is tuned to 60 Mc. The second local oscillator is also tuned and covers a frequency range of 230 Mc to 290 Mc. The tuning is accomplished by electronic means, however. The oscillator frequency is "swept" through this frequency range by the application of an external sawtooth.

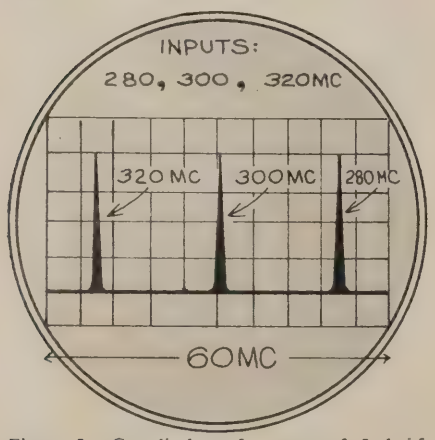


Figure 2. Crt display of output of 2nd i.f. (detected). Each cm = 6 Mc. Note that frequency is read from right to left on spectrum analyser displays.

The inputs to the 2nd mixer stage always exist within the range of 170 Mc to 230 Mc. No other signals can get through the first i.f. Note that the second local oscillator (Swept Local Oscillator — S.L.O.) sweeps through a range of 60 Mc — the band-width of the first i.f. Therefore, any signal from 170 Mc to 230 Mc, when combined with the 230-Mc to 290-Mc "sweep" of the S.L.O. will produce a 60-Mc difference frequency. The second i.f. has a relatively narrow band-with and is sensitive only to this 60-Mc difference.

To illustrate how a swept oscillator produces the 60-Mc i.f. frequency, consider the three input signals to the second mixer stage. The S.L.O. begins its normal sweep, starting at 230 Mc. To produce the desired i.f. frequency of 60 Mc there would have to be a 170-Mc signal present at the second detector input. There is none, thus no i.f. frequency is produced. The S.L.O. continues its sweep and passes through the frequency of 240-Mc. This mixes with the 180-Mc input and produces the 60-Mc i.f. frequency. As it sweeps through 260 Mc and 280 Mc, it mixes with the other two inputs and also produces the 60-Mc i.f. frequency.

Thus, by using a local oscillator that sweeps a certain range of frequencies, input signals to the mixer can be made to enter the second i.f. stage one by one, separated in time. This is the important thing to remember about the operation of the analyser.

Leaving the third mixer and i.f. for a moment, assume you have fed the output of the second i.f. into a detector. As the signals appear one by one at the output of the 2nd i.f., they are rectified, giving positive pulses which will cause vertical deflection on the face of a crt. In our typical spectrum analyser, the sawtooth that causes the S.L.O. to sweep through its frequency range is the same one that drives the horizontal circuits of the oscilloscope in which it is used. Thus, can be observed the three input signals on the crt, with the horizontal axis representing frequency. Study the following example, referring to Fig. 2.

The crt spot begins its sweep at the 0 centimetre mark at the left-hand side of the graticule. The S.L.O., in step with the crt spot, is now at the low-end of its frequency range, or 230 Mc. No output is observed, as discussed above; the spot is not deflected vertically. The S.L.O. sweeps through a range of 60 Mc. Thus, a complete sweep of the horizontal represents 60 Mc also, and each major graticule line represents 6 Mc (assuming a normal 10-cm scan). When the beam reaches a point 1.4cm from the left-hand side, the S.L.O. is sweeping through 240 Mc. This produces an output corresponding to the 180-Mc input signal and the crt beam is deflected vertically. The beam then passes through the 5-cm mark at which time the S.L.O. passes through its mid-range, or 260 Mc. At this time, the crt beam is deflected again, indicating the 200-Mc input signal on the crt. Likewise, the 220-Mc signal is displayed at the 8.6cm graticule line. The sweep is repetitive in normal operation and the result is a display similar to Figure 2. Note that the highest-frequency signal appears on the left-hand side. Frequency is read from right to left.

The previous example considered the S.L.O. sweeping through a 60-Mc range. This affords a "look" at a 60-Mc piece of the electromagnetic spectrum. The S.L.O. was set at maximum dispersion (range of frequencies swept by S.L.O.). The portion of the spectrum under analysis can also be narrowed. This is accomplished by decreasing the dispersion. If the dispersion is set at 20 Mc, the S.L.O. will sweep from 250 Mc to 270 Mc. Note that its centre frequency is still 260 Mc, as before. Figure 3 shows the display obtained on the simplified spectrum analyser, using this dispersion.

When the S.L.O. begins its sweep at the dispersion setting of 250 Mc, the 180-Mc signal at the input of the second mixer is heterodyned to a frequency of 70 Mc. This falls outside of the bandpass of the second i.f., which is tuned to 60 Mc. The 200-Mc signal produces a 50-Mc difference and is not accepted by the second i.f., either. The 220-Mc signal produces an even lower beat, 30 Mc, which is well outside the bandpass of the i.f. As the S.L.O. passes through 260 Mc, the 200-Mc signal from the first i.f. produces the 60-Mc beat signal which is accepted by the second i.f. The S.L.O. sweeps to 270 Mc and the same arithmetic proves that no other signal is displayed. Thus, of the original three signals, only one is displayed. The other two fall outside the area "Scanned' by the S.L.O. In effect, we have narrowed the "window", through which we observe a portion

Continued on Page 23

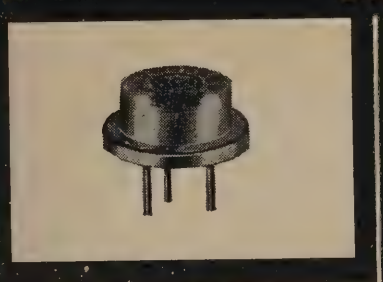
ENQUIRY CARD AD. 15

SILICON-CONTROLLED RECTIFIERS

from AWA

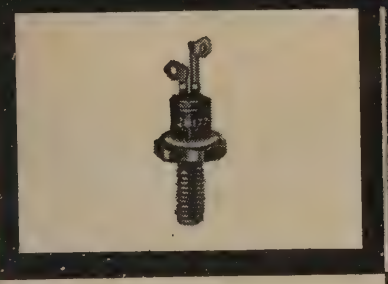
These RCA types cover your most important current requirements

6 TYPES PRICED FOR HIGH VOLUME USE



2N3528	2N3529	2N3228	2N3525	2N3668	2N3670
2 Amp IFRMS	2 Amp IFRMS	5 Amp IFRMS	5 Amp IFRMS	12.5 Amp IFRMS	12.5 Amp IFRMS
200 VRM(rep)	400 VRM(rep)	200 VRM(rep)	400 VRM(rep)	100 VRM(rep)	400 VRM(rep)

...AND 3 TYPES FOR HIGH-RELIABILITY USE



2N1770-78	2N1842A-50A	2N681-90
7.4 Amp IFRMS	16 Amp IFRMS	25 Amp IFRMS
25-500 Vrm(rep)	25-500 VRM(rep)	25-600 VRM(rep)

VR.27

Whether your design has application in stepless control, in mass-produced line-operated appliances, or in commercial and industrial power control, relaying, or other switching functions, RCA SCR's offer the extra design features for operation at full name-plate rating. Available only from AWA.

AMALGAMATED WIRELESS (AUSTRALASIA) N.Z. LTD.

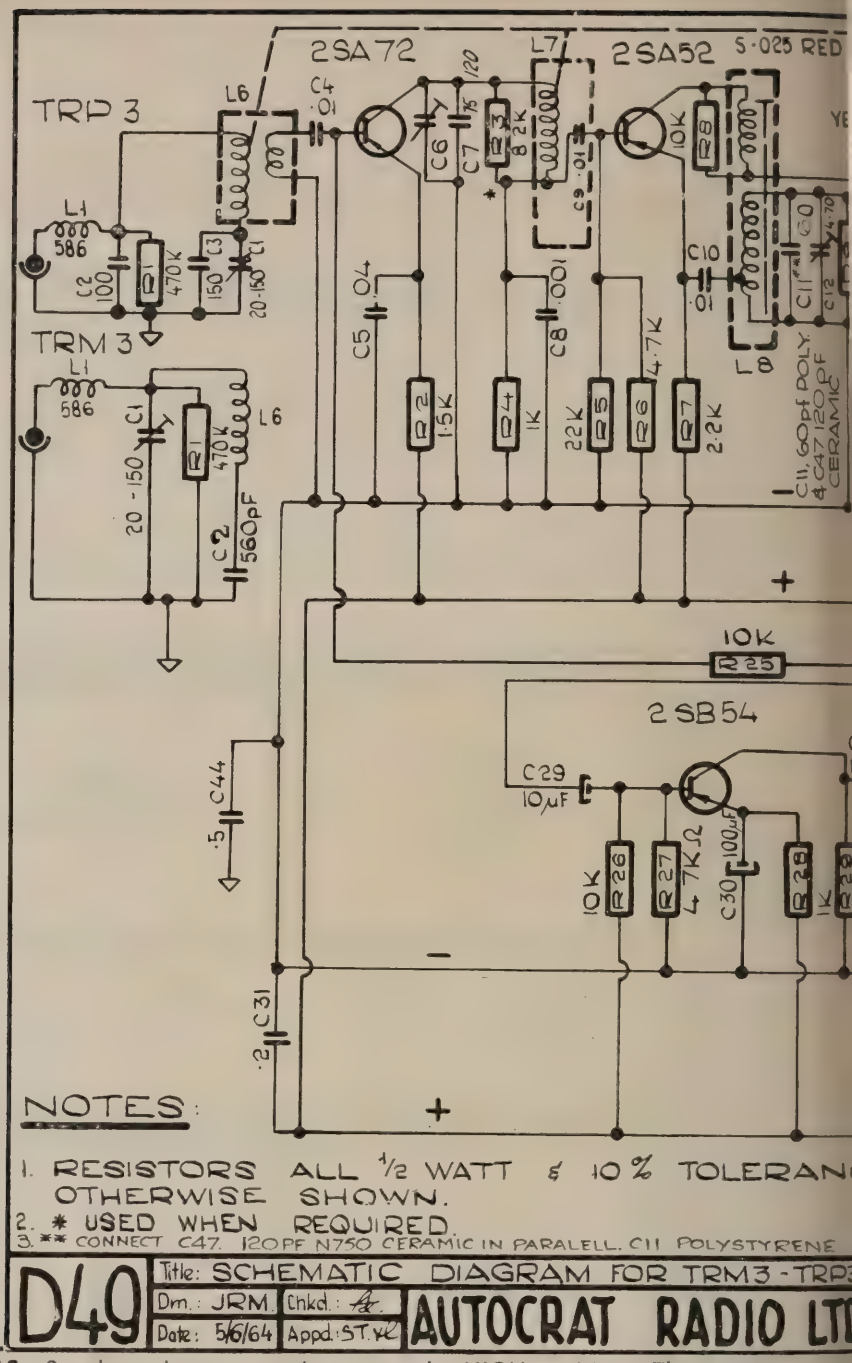
2nd Floor, Commerce House, Wakefield Street, P.O. Box 830, Wellington, Tel. 43-191

P.O. Box 1363	P.O. Box 2084	P.O. Box 932	P.O. Box 1026	P.O. Box 467
AUCKLAND	CHRISTCHURCH	PALMERSTON NORTH	DUNEDIN	INVERCARGILL
Tel. 10-129	Tel. 62-158	Tel. 83-671	Tel. 88-058	Tel. 89-777

Autocrat

Model TRM-3 TRP-3

all transistor auto radio



Circuit and Service Data

SPECIFICATIONS

TYPE
8 Transistors
12 Volt – POS. or NEG. Polarity, adjustable

FREQUENCY COVERAGE
530 – 1680 Kc/s

INTERMEDIATE FREQUENCY
455 Kc/s

TONE CONTROL
Continuously variable

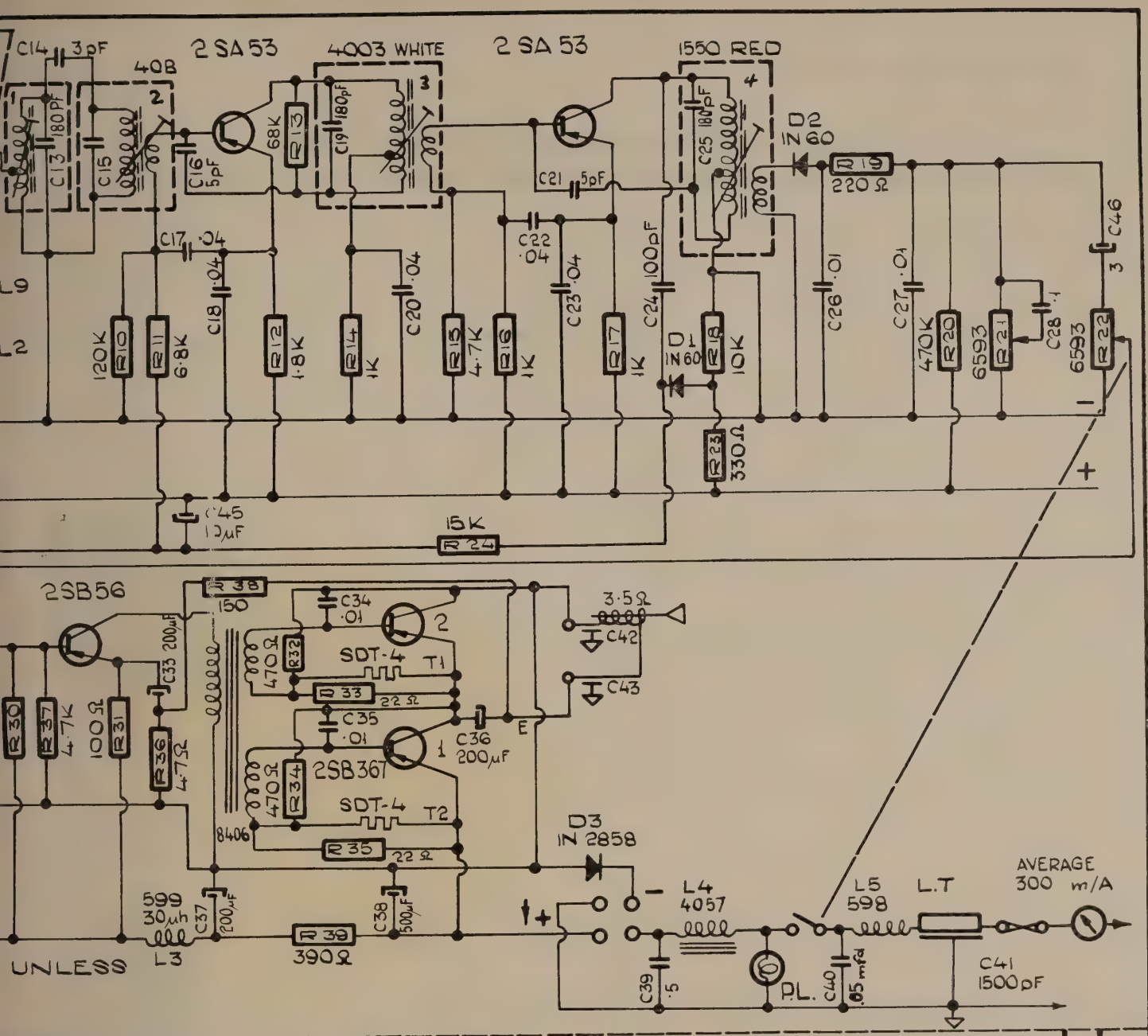
OUTPUT 2½ watts into 3 ohms

TRANSISTORS
V1, 2SA72 R.F. AMP
V2, 2SA52 Convertor
V3, 2SA53 I.F. AMP
V4, 2SA53 I.F. AMP
V5, 2SB54 1st A.F. AMP
V6, 2SB56 2 WD A.F. AMP
V7 & 8, 2SB367 Power output

DIODES 2 – IN60
1 – IN2858
OR ZS70

CONTROLS. Set the volume control at maximum and the tone control at the HIGH position. The tuning control as in the chart:–

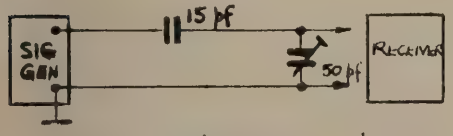
SIGNAL GENERATOR			RADIO		
STEP	CONNECTION TO RADIO	FREQ.	DIAL SETTING	SPECIAL INSTR.	ADJUST.
1	Connect signal generator to collector of V1 via A 0.1 med capacitor	455 Kc/s	Tuning Unit at H.F. end	Adjust for max. output in order given	I.F.T. 1, 2 3 & 4
2	Connect signal generator through 15 PFD series, 50 PFD, shunt to aerial I.P.	1680 Kc/s	Tune to extreme high end of dial	Adjust for max. output	C12 Osc trimmer
3	As in 2.	530 Kc/s	Tune to extreme low end of dial	Adjust for max. output	L8 Osc coil
REPEAT 2 & 3 UNTIL NO FURTHER ADJUSTMENT IS NECESSARY.					
4	As in 2.	1400 Kc/s	1400 Kc/s	Adjust for max. output	C1, AE, C6, RF trimmers



32	TRM3(MANUAL TUNER).	560	NIL	120pF				
31	TRP3(P.B. TUNER).	100	150	75	B	REDRAWN WITH MODIFICATIONS.	JRM	15/4/64
No	DESCRIPTION.	C2	C3	C7	ISS.	MODIFICATIONS	BY	DATE.

ALIGNMENT PROCEDURE. Input Voltage 13.2V.

The dummy antenna is sketched below:



Before switching on, make certain that the ± polarity plug is in the correct position. On the polarity plug there is a small slot or arrow which indicates the polarity of the set in relation to the stamped marking on the metal cabinet.

GENERAL. Allow the test equipment to warm up for 10-15 minutes, before starting the alignment.

SIGNAL GENERATOR. Use AM-RF signal generator, connect ground lead to chassis and the output as indicated in the alignment chart.

OUTPUT METER. Connect an output meter (voltmeter or oscilloscope) across the speaker voice coil connections.

OUTPUT LEVEL. Attentuate the signal generator output throughout the alignment so as to maintain the output level below 1 watt.

NOTES:–

1. To ensure the junction temperature of the output transistor is not exceeded do not operate the radio for long periods with a sustained high amplitude signal.
2. Take care to use alignment adjusting tools of the correct shape and size and do not use undue force; — to prevent damage of components.

WARNING

On no account should the voice coil connections of the loudspeaker become connected to the body of the cabinet or the car chassis. Failure to observe this precaution will result in failure of transistors and/or associated components.

Sample Electronics (N.Z.) Ltd. are pleased to announce two new sole agencies.

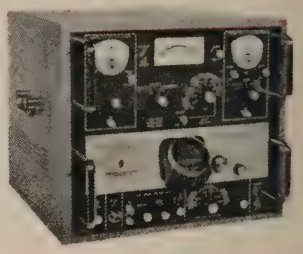
ONE ——————>

WEINSCHEL ENGINEERING
of Gaithersburg, Maryland, U.S.A.

THE PURSUIT OF PRECISION IN MICROWAVE MEASUREMENTS

Designers and manufacturers of precision microwave equipment

Fixed Coaxial Attenuators DC - 18 GHz in 10 models. Attenuation stds, DC - 10 GHz. Coaxial PWR divider DC - 10GHz, 1W, 10W and 20W. **Coaxial Terminations.** 1W - DC - 12.4 GHz. 20W DC - 3GHz. **Coaxial Stepattenuators.** 1W - DC - 12GHz. **Continuously Variable Attenuators.** 1W - 1 - 11GHz, 2W - DC - 1GHz. **Test Accessories.** Double stud tuner series, 40 MHz - 12.4 GHz. Barretter Mt. 50 MHz - 11 GHz. Coaxial noise suppressor, 10 MHz - 12.4GHz. **Coaxial Connectors** Type "N" DC - 18 GHz **Insertion Loss Measurements.** Single and dual channel. **Audio Substitution Instruments and Systems.** Modulators, Attenuators, Calibrators, Null Detectors. **IF Substitution Instruments and Systems.** Coaxial and wave guide mixers, oscillators, attenuators. **VSWR, Impedance and Phase Shift Measurement Instruments and Systems.** Tunable z Prec. phase shifters. **Microwave Power Measuring Instruments.** Broadband thermistor mount, Prec R.F. Power Bridge, Thermistor bridges. **Microwave Signal Sources** 20 Hz - 10.5 GHz ultrastable sources, power supplies, modulators. **Special Products** X Band radar test set, Pulse power calibrator, μ wave interferometer. **Warranty** fully backed by Sample's usual calibration laboratory facilities.



Attenuator and Signal Calibrator
Model VM - 3

TWO ——————>

SIERRA ELECTRONIC DIV.

The Electronic Division of PHILCO, U.S.A.

TRANSMISSION MEASUREMENT Tunable Voltmeters 10Hz - 15 MHz. **Wave Analyzers** 10Hz - 10 MHz. **Tracking Signal Generators** 5 KHz - 15 MHz. **Line and Cable Fault Locators** 0 - 200 miles. **Transistor Testers** Beta Gain to 1,000. FET GM - 2500 μ mhos.

POWER GENERATION MEASUREMENT R.F. Watt-meters and coaxial terminations DC - 5 GHz. **Bi-directional Power Monitors** 2 - 1000 MHz to 5 KW. **Power Attenuators** D.C. - 1000 MHz 20, 30, 50, 100W. **R.F. Power Sources** 25 - 1000 MHz 30 MW - 80W. 10-1500W. **Calorimeters** DC - 12.46 MHz, Thermopiles, Couplers, Detectors, and Filters.

Bi-Directional Power Monitor
Model 164B.

WE ARE SOLE AGENTS FOR:

BOONTON RADIO COMPANY (U.S.A.)
DECKER CORPORATION (U.S.A.)
EITEL-McCULLOUGH INC. (U.S.A.)
FAIRCHILD INTERNATIONAL
HEWLETT-PACKARD ASSOCIATES
KEITHLEY INSTRUMENTS INC. (U.S.A.)
MIKROS INCORPORATED (U.S.A.)
NUCLEAR CHICAGO
RADIATION INSTRUMENT DEVELOPMENT LABORATORIES INC. (U.S.A.)
A/S DANBRIDGE (DENMARK)
DU MONT LABORATORIES (U.S.A.)
ELECTRONIC MEASUREMENTS CO. INC.
JOHN FLUKE MNFG. CO. INC. (U.S.A.)
HEWLETT-PACKARD COMPANY (U.S.A.)
MELABS (U.S.A.)
F. L. MOSELEY COMPANY (U.S.A.)
GEORGE A. PHILBRICK RESEARCH INC.
SANBORN COMPANY (U.S.A.)
TALLY CORPORATION (U.S.A.)
DATAPULSE INCORPORATED (U.S.A.)
DYMEC INCORPORATED (U.S.A.)
ELECTRO SCIENTIFIC INDUSTRIES (U.S.A.)
HARRISON LABORATORIES
HOLT INSTRUMENT LABORATORIES (U.S.A.)
MICA CORPORATION (U.S.A.)
NESCO INSTRUMENTS INC (U.S.A.)
RADIO FREQUENCY LABORATORIES (U.S.A.)
S-E LABORAORIES LTD. (ENGLAND)
TECHNICAL RESEARCH GROUP INC. (U.S.A.)

SAMPLE ELECTRONICS (N.Z.) LTD.

8 MATIPO STREET, ONEHUNGA, S.E.5. AUCKLAND, NEW ZEALAND
TELEPHONE 567-356

SERVICE AND CALIBRATION FACILITIES AVAILABLE

of the spectrum, in order to take a closer look at it. (A good analogy would be a zoom movie camera that closes in on a subject). As the dispersion of the S.L.O. is narrowed to sweep a smaller range of frequencies, we "close in" on the centre portion of the output of the first i.f. As the observed portion still fills the entire horizontal sweep of the oscilloscope, the signal is spread out more. This gives better resolution in the case of closely-associated sine waves.

Figure 4 represents a display with the dispersion set at 10 Mc. Note that an upper and a lower sideband are beginning to emerge. Although at first they could not be seen, these sidebands were associated with the 200-Mc signal all along.: With a wide dispersion, the resolution was so poor, they all blended together. The following circuitry of the analyser can spread, or resolve, these signals even more.

A front-panel vernier labelled "Centre Frequency", controls a dc voltage to the S.L.O. This provides a slight shift of the S.L.O. centre frequency. This is useful for lining up the display with a desired graticule line for subsequent measurement.

Because of the wide range of possible input voltages, a 1 to 51-db attenuator network is inserted between the second mixer and the second i.f. In addition, the second i.f. also has a "Variable Gain" control on the front-panel.

A THIRD I.F. IS ADDED

The output of the 60-Mc second i.f. is still too broad for resolution of closely-associated signals. So it is converted a third time! A third L.O., operating at a fixed frequency of 65 Mc, beats in the third mixer with the 60-Mc output and produces an i.f. frequency of 5 Mc. This signal is fed into the third i.f. which is fixed-tuned to 5 Mc. This i.f. has variable bandwidth and can be changed from 1 kc to 100 kc. Therefore, the resolution can be varied by changing the actual bandwidth of the i.f. stage. The output of the third i.f. is fed to the detector.

THE DETECTOR CIRCUIT

All signals appearing at the input of the detector circuit are both positive and negative. There is no need to display the entire signal because one-half of it would simply mirror the other. So the signals are detected, or rectified, and passed on to a video amplifier.

The detector circuit provides three different outputs: Linear, Logarithmic, and Square-law. We'll consider each in turn.

The Linear output increases proportionally as the input increases. In other words, if an input voltage to the detector causes a crt deflection of 4 cm, doubling the input would cause a crt deflection of 8 cm.

The Logarithmic output reflects a decrease in the gain of the detector circuit as the input is increased. This has the effect of compressing the larger input signals and increasing the dynamic range of the detector input. The output is proportional to the log of the input signal to the detector. The crt vertical deflection increases as the square root of the input voltage. This is equal to the db gain of the display. Increasing the input amplitude by a factor of four only doubles the height of the vertical display.

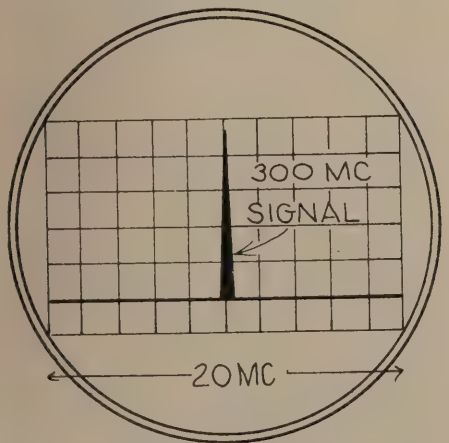


Figure 3. Dispersion, or bandwidth, set at 20 Mc. Each cm = 2 Mc.

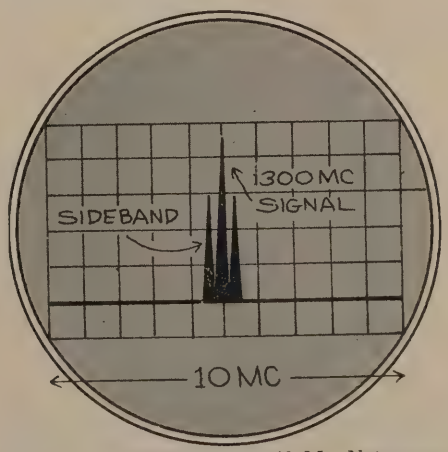


Figure 4. Dispersion set at 10 Mc. Note emergence of sidebands.

DECIBELS

A brief description of decibels gives a better understanding of the logarithmic output.

A decibel is one-tenth of a bel. A bel is the same thing as a power of ten. Thus: 50 db is equal to five bels. This is the same as 10 to the 5th power, of 10^5.

If we increase the power level of a signal by 60 db, we increase it 10^6 times — a gain of 1,000,000. Increasing a one-watt signal by 60 db increases it to one million watts.

Remember that db merely expresses the difference between two power levels. By itself, it means nothing, nor does it represent any actual quantity of power. If the example above were one microwatt, a 60 db gain would bring the power up to one watt. So the same 60 db expressed a difference of almost one million watts in the first example and only one watt in the second.

Gains of whole bels, 1, 2, 3, etc. . . . can easily be calculated in the head. One bel (10 db), for example, means a power gain of 10^1, or ten. Two bels, (20db), means a power gain of 10^2, or one hundred. And so on.

Unfortunately, gain is not always expressed in even numbers of bels. What about a gain of 33 db? This is a gain of 3.3 bels, or $10^{3.3}$. This means 10^3 times $10^{.3}$. 10^3 is easy: 1000. What about $10^{.3}$? For this, it is necessary to refer to a table of fractional exponents. This shows that 0.3 corresponds to 2. So 10^3, or 1000, is multiplied by 2. A 33 db gain, therefore, is equal to a gain of two thousand.

Assume that an amplifier has an input of 200 milliwatts. The gain is 33 db. The output, in watts, would be 400 watts. ($0.2 \times 10^{3.3}$).

Db's are also used to express a loss. We can still consider, in the case of our example, that the difference between two signals is 33 db, but as we now desire to express a loss in power, the figure of 2000 must be divided into one to obtain its reciprocal. In this second case, the initial power of 200 milliwatts must be multiplied not by 2000, but one divided by 2000, or 0.0005. This reduces the 200 milliwatts to 100 microwatts.

To be concluded

SERVICEMAN'S COLUMN

Conducted by

J. Whitley Stokes

Once again servicemen are under fire — although perhaps 'under fire' is not quite the correct term to use as it implies condemnation, whereas the article referred to may be said to have been written more in sorrow than in anger.

Under the heading "Repairmen Rule the Roost in Machine Society," a New Zealand Herald staff correspondent recently reviewed the situation existing today where the increase of those engaged in 'service' trades has not kept pace with the ever increasing demand for their services.

A suggestion was put forward that in the process, the repairman has become one of the most exclusive members of the community — funny how I had never realised this before. Had you?

If it is any consolation, servicemen are not the only ones singled out for criticism; also included are plumbers, electricians and motor mechanics. However I would question the inclusion of tailors under the listing of the "seven most needed" repairmen. Surely a tailor could more properly be classified under the heading of "manufacturer". Perhaps the writer did not own a TV set but I think most set owners would agree that as repairmen, TV servicemen fill a far more pressing need in our "machine society" than do tailors.

One observation made in the article was that the shortage of all types of repairmen has resulted in increasing complaints against them due to shoddy workmanship, long delays, and excessive charges. Of these three complaints the serviceman as an individual should be mainly concerned as to whether the charge of shoddy workmanship is justified. Pressure of work should never be advanced as a reason for a substandard job; anyone undertaking any job has a moral obligation to do it to the best of his ability. Long delays in getting a job done, are, of course, the direct result of over-full employment. The situation cannot be blamed on the serviceman — he like his customer, is a mere victim of circumstance.

As for the instances quoted of supposedly excessive charges for small jobs, I have no intention of becoming involved in this argument but will content myself with observing that the vexed question of what is a reasonable price, or what is an excessive price, existed long before the present day labour shortages and high wages. Some people still complain about being overcharged 35 years ago in depression days.

The article concludes with the remarks:— "The layman . . . . . feels that it is not so much a matter of the labour shortage as it is of repairmen failing to take a pride in their work".

This is a reiteration of the earlier plaint of shoddy workmanship, or so it seems to me. Personally I consider the situation cannot be as bad as the writer makes out and the reason for this belief lies in the minimal number of complaints received about other servicemen's work. My own experience has been that there were infinitely more complaints over unsatisfactory work in the immediate post-war period, chiefly as the result of the operations of two now long defunct radio service organisations, than one ever receives nowadays.

Obviously servicemen don't have to be reminded of the many difficulties standing in the way of attaining that pride of workmanship. It is one thing for a tailor to take a pride in producing a fine suit or a paperhanger to make a perfect job of repapering a room, but quite another for a radio or TV serviceman to take a pride in patching up some ailing and often dirty and neglected 'gram or TV set.

Additionally in the case of TV there is ever-present pressure of urgency brought about by the demands of many set owners for immediate service at all hours of the day or night. Then there's the question of working conditions. I'm sure most factory workers would be up in arms if asked to ensure good workmanship under the working conditions encountered by servicemen when carrying out repairs 'in the home'.

Squatting or kneeling in a dark corner of the living room flanked by collections of precariously balanced pot plants and sundry ornaments where every movement must be curtailed lest something is sent crashing to the floor is only one of the hazards encountered. Three-year-old little Sebastians exploring the tool kit whilst ones back is turned and making off unnoticed with screwdriver or pliers, quite oblivious to Mummy's "Don't get in the man's way, darling".

Or perhaps it may be the man of the house who appears to be so concerned about having something put across him that he stands behinds you watching every move and breathing down your neck in the process. Now I ask you: Who can be expected to concentrate on the job in hand with such distractions? It is only the fact that such instances are in the minority that prevents servicemen going completely 'round the bend'.

As for pride of workmanship — what serviceman hasn't been forced to do less than a perfect job under such conditions? It is one thing to attain a high degree of efficiency in a well-equipped workshop with every facility and convenience at hand and quite another to achieve the same efficiency under 'in the home' conditions.

FIRST EUROPEAN MICRO-COMPUTER

by Luscombe Whyte

"Nanoseconds" is the new word in the laboratories and air-filtered workshops near Chelmsford, Essex, England, where the first of Europe's third-generation computers is being assembled. A nanosecond is one thousand-millionth of a second — the time which light, or electricity, takes to travel one foot; and it is the unit with which some operating speeds of the new Myriad computer must be measured.

Myriad is about to launch not only a new word but a new age in computing. Production models, due out this year, will be the first European machines based entirely on microelectronic techniques. They will demonstrate how normal electronic circuits, can be replaced by minute chips of silicon, capable of holding the equivalent of dozens of conventional components within a match-head of matter. Such "integrated circuits" have now been used to build a complete, ultra-high speed computer, able to handle massive and complex operations, which is housed mainly in one pedestal of what appears to be a handsome office desk measuring 6 feet by 3 feet by 2 feet 9 inches. The Myriad's predecessor was made by conventional methods for monitoring and control operations at Wylfa Head atomic power station, and occupied four large cabinets about 7 feet high.

Exceptional Working Speeds

The two computers are comparable in capacity, but Myriad packs ten times as many "components" into the cubic measure and its electronics occupy about one-tenth of the space. Thanks largely to its new microelectronic design and the short signal-distances involved, it is also about ten times as fast. Apart from such fantastic figures as its stage delay of eight nanoseconds, and the data transfer period between registers of 100 nanoseconds, ordinary working speeds are exceptional.

Access time to basic storage is about 0.4 microseconds and cycle time 1.2 microseconds. Simple orders — add, fetch, store — are executed in 2.5 and multiplication in 11 microseconds. Very fast input/output operations, essential to efficient real-time working, result from a speed of 5-8 microseconds to input or output a word by interrupt.

In addition to extreme speed and compactness is exceptional reliability, which some experts consider to be the greatest of all microelectronic's advantages. Myriad's solid-state, low-mass integrated circuits — their minute parts embedded in silicon and virtually immune to damage — and its vastly reduced amount of wiring and number of connections should result in a negligible failure rate and an operating life for circuits equal to their "shelf life".

The computer's developers and makers — the Marconi Company Ltd., whose computer interests were recently merged with others in the parent group to form English Electric-Leo-Marconi Computers Ltd. — claim that Myriad is the most advanced process control computer commercially available in the world. At a price of between £34,000 and £65,000, it is also said to be considerably cheaper than any comparable machine. Even in its standard form it competes directly in performance with many large, costly, specialised scientific computers. A team of several Myriads, with additional storage, could form a system equal in performance with the largest existing machines and offer improved reliability as a bonus.

Myriad is the first of a family of ultra-fast digital machines for "real time" and "on line" operations — in computing terminology. This means that it can control the present-time operations of a number of processes, while at the same time monitoring, recording, calculating and reporting on them, and will present information on demand about the up-to-the-moment state of operations.

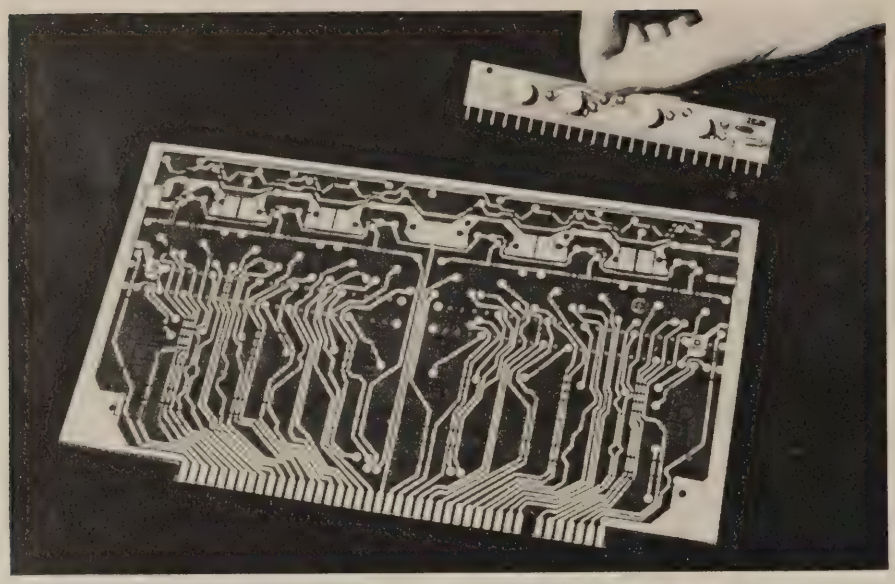
The Myriad high-speed real-time computer is housed in a desk measuring 6 feet by 3 feet by 2 feet 9 inches.

The production Myriad's heart — the central processing unit with its supremely compact logic and storage modules, built up from basic packages of micro-circuits — can be connected to a variety of sophisticated peripheral systems. Up to 2,000 devices at one time can help to operate, and be operated by, the central processor and the computer can be equipped to sample and control virtually any process. Extra peripheral control circuits can be housed in a separate cabinet and coupled up to meet the demand.

The computer's standard "highway" system, with only three sets of wires, enables the central processor to alert any chosen one of many peripherals connected to it by means of a code signal. Data can then be transferred to, or received from it without affecting any of the other units. The highway also allows additions or removals of peripheral equipment without interruption of the general operations.

Multilevel Interrupt System

Another refinement valuable in complex operations is a highspeed



A main board and sub-board from the Myriad computer. Up to 20 sub-boards can be plugged into each main board and up to 40 main boards make up the computer's logic module.

multilevel interrupt system. This works automatically to give access to the central computer within 1.5-2 microseconds to any device needed to communicate urgent information. Requests are handled on a priority basis through eight separate interrupt channels. The main programme is undisturbed while the computer deals with such interrupts.

Orders for Myriad have been received for applications ranging from electricity grid control and automatic telegraph message switching to satellite communications. In industry, it will be used especially for monitoring and control of complicated processes such as those found in steel manufacture and in nuclear and large conventional power stations. In communications, Myriad's almost instant response, calculation and action suggest many roles. It can, for example, handle 130 teleprinter channels at once, with no additional equipment, and it might have been designed expressly for the complexities of air-traffic — and possibly road-traffic — control.

Simultaneous Observations

Universities and research establishments are likely to use Myriad for their more difficult calculations and the computer is particularly well equipped for the many simultaneous observations, calculations and actions demanded by such electronic installations as aircrew-training and other simulators. Its full commercial possibilities have not yet been assessed, but there should be many — especially for massive handling and calculating tasks in large, multi-branch businesses. One likely application is as a central handling station for incoming and outgoing data involving numerous scattered stations.

Services Offered And Advantages

Myriad is not intended to replace existing second-generation machines, but to complement them; it may even work with them. The efficient systems now being produced by several British concerns, including Myriad's own group, are highly-developed affairs, far removed from the pioneer transistorised machines of the late 1950s which first replaced the old, rambling, failure-prone valve assemblies. They are fast, capacious, compact and reliable enough to play an important and increasing role for years to come. The third-generation machines offer something different — in speed, compactness, reliability and ease of maintenance, in circuit design and manufacture, and in capital and running cost (and therefore in new spheres of usefulness).

Today's average computer is a highly-miniaturised collection of many small, individual transistors, diodes, resistors, capacitors and other components, neatly wired together on boards. Some systems have 200,000 or so separate parts and even more electrical connections. They cannot be made much smaller or simpler. And, to satisfy demands which constantly grow in complexity and magnitude, their own size, complexity, cost and operational and maintenance problems must grow in proportion.

Microelectronics has abolished nearly all the components, as such; eliminated most of the connections and miles of wiring; and micromodular design permits almost infinite extendability.

New Science

"What is involved is a new concept of electronic design and a revolution in traditional methods of manufacture," states Dr. S. Forte, chief of Marconi's Microelectronics Division Applications Engineering Group. "Here is a new science which permits design and fabrication of electronic circuits, performing recognisable electronic functions of a complex nature, in one solid piece of material the size of a pinhead. Very complex electronic functions are performed in a simple piece of semi-conductor material measuring 0.05 inch square."

The present state of microelectronics stems largely from the discovery that thin wafers of such materials as pure silicon can be made to reproduce the functions of electronic components, or of complete circuits, by diffusing hot, vapourised "dopants" of appropriate materials into minute patterns etched on their surface by a photolithographic process; and that these wafers can then be diced into hundreds of minute circuits or "components" and assembled by infinitely delicate, hand-controlled machines.

Two Kinds Of Circuits

Integrated circuits, as used in Myriad, are mainly of two kinds —monolithic and multi-chip. The first may be a complete circuit, to perform a computer logic function, diffused into a 0.05 inch square chip. Its diffused circuit elements are interconnected by a network

of aluminium conductors, deposited according to pattern by an evaporation technique. Each circuit is alloyed to the base, 0.25 inch in diameter, of a miniature TO-5 metal can of the kind used to hold a normal transistor. Bonded gold wires connect the circuit to the eight or more plug-in pins protruding from the can.

The assembled cans are vacuum-baked at high temperature to remove all moisture and finally sealed by welding in an atmosphere of inert gas. The resulting circuits, though minute, are far from frail. They are, in effect, tiny solid modules — impenetrable by contaminants and of low mass and able to withstand high magnitudes of shock and vibration. Each one is tested several times. While still in slice form, individual electrical evaluations are carried out under microscopic scrutiny and faulty devices eliminated. Encapsulated circuits are subjected to centrifugal forces of up to 20,000 "g". Batches are put through life-testing spells in temperature-controlled rooms. Once a microelectronic circuit has passed such tests it is likely to continue fault-free for an indefinite time.

The multi-chip integrated circuit is produced in a similar way, except that each circuit is assembled in the cans from minute packages of separate component chips, about 0.02 inch across, and interconnected by gold wire.

Particular Advantages

Each circuit has particular advantages. The monolithic circuit's evaporated conductors are, by present standards, of unbeatable reliability. The multi-chip — used by the company for its high-speed logic modules — has better isolation between circuit components; each type of component can be made from the most favourable materials in optimum conditions; and extra, redundant component chips can be included to allow for substitution in case of failures. One multi-chip circuit may contain transistor, diode and resistor chips with several components in each.

A large proportion of the central computer's most active circuits are built up from these TO-5 can units, plugged in with the minimum of ordinary wiring and connections. Modular construction builds up Myriad's logic from printed-circuit, fibre-glass sub-boards, 4 inches long, each mounting four cans. Sub-boards are mounted in lots of about 20 on larger mother-boards — each specific to a particular function — with printed circuitry and edge connectors. Up to 40 of these can be slid into a case measuring only 2 feet by 2 feet by 9 inches. This forms the computer's entire main logic module, or calculating brain. Its standard memory is housed in two similar-sized main storage modules, with a capacity of 4,096 24-bit words, sited with the logic in one desk pedestal. The other main stores can be accommodated, if needed, in an L-shaped desk extension. The rear of the desk holds power supply equipment, including stand-by batteries to maintain operations for about three minutes during any voltage failure.

Concentration of such a high-performance computer into this

Continued overleaf

British Manufacturers Join Forces

Two leading British electronics companies, Marconi and Ferranti, have announced that a licence agreement has been signed in a bid to win a major share of the growing world market for microelectronics. Under the terms of this new agreement, the Marconi Company will manufacture and sell the advanced range of silicon microcircuits designed and sold by Ferranti under the name of Micronor II.

This agreement will not only increase the production capacity available for this new range of integrated circuits, but will also provide users with the safety and convenience of a second source of supply. This is an important sales feature for this type of component, which will be used in quantity production equipment.

Extensive new production facilities for Micronor II are being commissioned by the Marconi Company at Witham, near Chelmsford, and by Ferranti, at their Manchester headquarters. The two companies already manufacture more than 70% of the silicon integrated circuits in the United Kingdom, and this new agreement will provide them with a greatly increased sales potential in world markets in this vitally important and rapidly expanding field.

Micronor II is a new range of ultra fast silicon integrated circuits designed for use in computer and other logic applications. They are available in many different circuits including multiple gates, power stages, J-K Flip Flops etc., all of which have been subjected to twelve months intensive systems proving trials.

Navy Radar On Diet

Weight reduction is on the minds of many Americans today — including engineers at the Navy's Bureau of Ships. While the overweight citizen is considering methods of cutting down excess poundage on his frame, the Navy is scrutinizing methods of accomplishing similar results on large pieces of electronic equipment. For example, a recent study of the Bureau of Ships indicated that a standard piece of radar designated the AN/UPS-1 and weighing nearly 3,000 pounds could be reduced in weight by as much as 70 per cent.

But reducing the weight of a big radar is much like those easy-sounding diets. Neither is worth much unless they work in practice. The Navy has announced it has awarded a contract to evaluate the weight reducing techniques by building a lightweight version of the AN/UPS-1.

The Bureau of Ships has modified its normally tight restrictions on standard materials and specifications to permit the big cutbacks in weight.

Advanced engineering techniques and the science of microelectronics would make possible the 70 per cent reduction in weight.

The lightweight version of the radar will also undergo a vast reduction in volume and at the same time will be more reliable and have a longer operating life.

Transistor Patent Expires

The U.K. High Court has rejected a claim by three U.S. companies, Western Electric, American Telephone and Bell Telephone Laboratories, that a Western Electric patent relating to transistors should be renewed. The patent covered the idea and manufacture of transistors and affected most electronics companies in Britain.

The decision was welcomed by Mr C. O. Stanley, chairman of the Pye group, who said it would facilitate cheaper production of transistors and associated equipment. Export advantages to Britain were foreseen. Other Western Electric transistor patents expire in 1967.

Development work leasing to the patent cost £140,000, the judge noted in his decision. The patent holders, however, had derived £4½ million from royalties, including £1½ million from the U.K.

CHANGES within PLESSEY (N.Z.)

On November 1 last, Plessey (N.Z.) Ltd. announced considerable re-organisation details involving the amalgamation of their group of companies activities under the combined name of Plessey (N.Z.) Ltd. To implement this policy major administration changes have been announced by Mr. G. F. Perry, Managing Director. The following re-organisation has become effective from January 1, 1966.

Plessey (N.Z.) Ltd., will operate under three divisions each with its own Divisional Manager. These divisions are:

Components division, Mr. H. M. Brown; **Rental division,** Mr. F. P. Walker; **Systems division,** Mr. M. K. Nasmith.

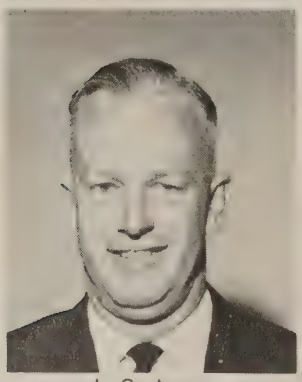
To co-ordinate the activities of these divisions a Central Services section has been created.

Appointments are:

Mr. R. A. Harris, **Administration Manager;** Mr. L. G. Annan, **Company Secretary;** Mr. E. W. Bensemann, **Company Engineer;** Mr. P. M. Cummuskey, **Marketing Manager.**

G. F. Perry

H. M. Brown


L. G. Annan

P. M. Cummuskey

F. P. Walker

R. A. Harris

E. W. Bensemann

M. K. Naismith

DIVISION OF COMPANY

The General Electric Company Ltd., (G.E.C.) and Associated Electrical Industries Ltd. (A.E.I.) have announced that they have agreed to divide the trading of their jointly owned company, S.G.E. Signals Ltd., into separate road and rail businesses. G.E.C. now owns and manages the business of road signalling and A.E.I. owns and manages that of rail signalling.

Consequent upon this agreement S.G.E. Signals Ltd. has changed its name to G.E.C. Road Signals Ltd. and is controlled by G.E.C. Electronics Ltd. Railway signalling has been transferred to a new A.E.I. Subsidiary — S.G.E. Railway Signals Ltd.

In Britain, G.E.C. Road Signals continues to operate from East Lane, Wembley, and S.G.E. Railway Signals Ltd. will operate from Signal House, Lion Road, Harrow.

The New Zealand agency for road traffic signals has consequently been transferred from Cory, Wright & Salmon to G.E.C. (New Zealand) Ltd., to whom all future enquiries should be addressed.

OVERSEAS TRADE STUDY

Radio and television engineer, Mr R. J. Barnes, received one of the eight awards for overseas trade study to be granted by the New Zealand Craftsman Training Foundation, from the Governor General, Sir Bernard Fergusson, in Auckland.

Mr Barnes will go to Australia for two years' to study colour television and telecommunications.

The awards, the first to be made by the Foundation, which is sponsored by New Zealand industrialists, are to enable outstanding young tradesman to gain experience overseas which can be related to New Zealand industry. The first eignt award winners will go to either Australia or the United Kingdom.

MICRO - COMPUTERS

Continued from previous page

small volume demonstrates graphically the fantastic shrinking power of microelectronics.

Outside the computer desk extra peripheral storage units, with quick access, may be provided on magnetic drums holding up to 80,000 words, with a transfer rate of 50,000 words/second and average access time of 0.01 second, and on magnetic tape reels totalling 786,000 words.

Quick Inexpensive Servicing

The final refinement of Myriad is the use of programmed fault-finding, which eliminates the need to employ a first-grade service engineer. Any failure is first traced easily, by tests and diagnostic programmes, to one of the functional main boards, which is slid out. If resumed working is urgent, a fresh set of sub-boards can be plugged into another main board and this inserted and operations resumed within ten minutes. Given more time, a failure may be narrowed down to a sub-board, and finally to one tiny semi-conductor package, which is replaced.

One result of this system is economy in holding of spares, since throw-aways would usually consist of single, standardised, cheaply replaced plug-in units.

The failure rate when Myriad is working is as yet unknown. Failure-tests with a prototype computer have reached tens of millions of component-hours — so far without result.

LISTENING POST

by michael lawrence

All times are in GMT and frequencies in kilocycles.

NEW AFRICAN SERVICE FROM CANADA

Radio Canada has inaugurated a new daily service for West and Central Africa from 0730 - 0800 in English and from 0800 - 0815 in French. This programme is radiated to Europe on 9625 and 5990 from where it is rebroadcast to Africa from 75 kW BBC transmitters on 17715, 15390 and 11880.

To accommodate this service the Australasian transmission has been retimed to 0830 - 0930 on the same frequencies as before, that is 9625 and 5970.

The original African service from 1830 - 1915 in English and 1915 - 1958 in French still exists and is broadcast from Canada on 17820, 15320 and 11720.

BBC transmitters are also used to relay several other CBC programmes to Europe. Transmissions from 1345 - 1415 in Ukranian and 1415 - 1445 in Russian are relayed from the BBC on 9510, 11820, 11780, 15435 and 15180. From 1445 - 1515 in Czech and Slovak, 1530 - 1600 in Polish and 1615 - 1630 in Czech and Slovak are relayed on 9510 and 11820. All these programmes are transmitted from Canada on 17820, 15320 and 11720.

INDIA. From 2045 an English language programme is transmitted to Australia and N.Z. from All India Radio on 9915 and 11905. At this time the same programme is also being beamed to the U.K. on 7215 and 9915.

CZECHOSLOVAKIA. Two English language transmissions radiated to North America from Radio Prague are at 0100 on 5930, 7115, 7345, 9505 and 11990 and at 0330 on 6090, 7115, 7345, 9505 and 11990.

The English language service to Australia, N.Z., and the Far East operates at 0700 on 9505, 15230, 15285 and 21450 with 6055 beamed to Europe.

FIJI. The Fiji Broadcasting Commission opens transmission at 1800 in Fijian on 6005 and 3284 and in English on 5980 and 3230. The two higher frequencies, as heard in Wellington, are heavily interferred with and all frequencies fade out about 2000 but the two 3 Mc/s channels are audible again between about 0600 and closedown at 1030.

EGYPT. The United Arab Republic Broadcasting Corporation transmits in English to Europe from 2145 - 2315 on 9475 and 11915. The 9475 channel provides best reception. The programme is mainly musical and a news bulletin is broadcast at 2200.

A session of dictation news in English is broadcast by the same station at 0630 on 11915.

TURKEY. From 0425 - 0700 a relay of the home service in the Turkish language can be heard from Radio Ankara on 15160 and 9745. The 9 Mc/s frequency suffers heavy interference from Radio Moscow but the other channel is clear.

GERMAN FEDERAL REPUBLIC. Two sessions of news feeds for use by North American broadcasting stations are transmitted from Mondays to Saturdays by Deutsche Welle. These programmes contain observers reports on European and German news and are transmitted from 2050 - 2100 on 9735, 11925 and 15405 and at 1045 on 11905 and 15315.

On Sundays, a musical programme is broadcast at these times.

SOUTH AFRICA. A bulletin of English news can be heard from Radio South Africa from 0415 - 0427 on 9525 and 7270.

GERMAN DEMOCRATIC REPUBLIC. The current English language schedule for Radio Berlin International's South Asian service is: 0700 - 0730 on 15240; 1200 - 1300 on 15240 and 15165; 1400 - 1500 and 1530 - 1600 on 11795.

MALAYSIA. Radio Malysia transmits a service to Australia and N.Z. from 1115 - 1215 on 11900, 6175 and 6100.

The home service in English broadcast from Radio Malaysia from 0930 - 1630 provides a weak signal in N.Z. on 4985 but it improves slightly later in the transmission.

NORTH KOREA. Radio Pyongyang broadcasts to South East Asia in English at 0800 - 0900 on 13780 and 7580 and at 1100 - 1200 on 13780. The Near and Middle East service is broadcast from 1900 - 2000 on 7580 and 6540.

TAIWAN. The English language schedule for the Voice of Free China in Taipei is: 0250 - 0350 on 7130, 11825, 11860, 15125, 15345, 17720 and 17780; 1000 - 1045 on 7130, 9655, 9685, 11825 and 11860; 1530 - 1610 on 7130, 9685, 9765, 11725, 11825, 17780 and 17890.

The Dragon Show from 1130 - 1200 can be heard on 7130, 9685, 11825 and 17890.

U.S.S.R. Radio Kiev's English programme from 0430 - 0500 is transmitted on 9665.

VATICAN STATE. Vatican Radio directs a short programme to the Australia and N.Z. area at 1130 on 15115 and 11785.

BBC RELAYS. The World Service of the BBC is rebroadcast by three relay stations:

East Mediterranean Relay: 0500 - 0800 and 0900 - 1745 on 17885; 0400 - 0800, 1100 - 1130, 1400 - 1415 and 1800 - 1815 on 15420; 0900 - 1600 on 15260; 1800 - 1815 on 11820; 0300 - 0415 and 0600 - 0800 on 11720; 0300 - 0330 and 0545 - 0800 on 9650; 0000 - 0015, 0145 - 0215, 0300 - 0415, 1645 - 1815 and 2300 - 2315 on 9625; 0000 - 0030, 0145 - 0215, 0300 - 0345, 0545 - 0800 and 2300 - 2315 on 7140; 0300 - 0345 and 0545 - 0800 on 6120.

West African Relay: 0600 - 0630, 0700 - 0730, 1600 - 1700, 1745 - 1830, 2000 - 2015 and 2115 - 2230 on 9555.

Far Eastern Relay: 0900 - 1130 on 17880; 0900 - 1345 on 15435; 0000 - 0015, 0900 - 0945, 1400 - 1745 and 2300 - 2315 on 11955; 0000 - 0030 on 11890; 0900 - 1315 on 11750; 0000 - 0015, 0900 - 0945, 1100 - 1115, 1300 - 1315, 1415 - 1745 and 2300 - 2315 on 9725; 1300 - 1745 on 9580; 0000 - 0030 on 9570; 0900 - 0945 and 1100 - 1115 on 7235; 1300 - 1345, 1400 - 1745 and 2300 - 2315 on 7120; 1400 - 1745 on 6110.

RUMANIA. Radio Bucharest's first broadcast in English to North America can be heard from 0130 - 0230 on 11940, 11810, 9590, 9510, 6190 and 6150.

SWITZERLAND. The S.B.C. broadcasts to North America from 0130 - 0230 on 6120, 9535 and 11715. The same programme is beamed to Australia and N.Z. on 11775.

a new *look* at

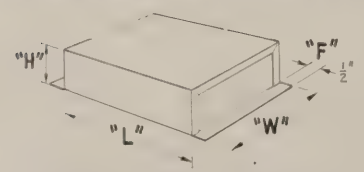
Diode Modulators

Engineers for years have designed DC amplifier systems using diode modulators to convert the low level DC signal into AC for easy amplification. This approach can result in a system with inherently high stability, since the AC amplifier gain can be stabilized with feedback. The stability of this system depends, of course, on the stability of the forward and inverse characteristics of diodes used in the modulators.

Ten years ago the designer could choose between only selenium diodes, copper oxide diodes, and point contact germanium diodes. None of these was desirable because of high inverse leakage (particularly at high temperatures). A substantial reduction in inverse leakage accompanied the development of the silicon diode. Now further development has resulted in a new modulator diode having high temperature leakage no greater than the room temperature leakage of ordinary silicon diodes. In addition, careful matching insures a smaller unbalance on the input voltage than previously available.

ENQUIRY CARD AD. 17

BLANK CHASSIS



MADE TO ORDER

Chassis in Aluminium Alloy
(Corrosive resistant with twice the strength of Aluminium to B.S.S. 1470, N.S 5)
We are especially set-up to handle economically small quantity orders
Preferred height 2".
We can generally offer a 2 day service.

WHEN ORDERING PLEASE STATE:
L x W x H x material gauge and whether inside or outside mounting flange.

Example of Single Prices
7" x 3" x 2" x 20 g. = 9/9
7" x 5" x 2" x 20g. = 10/6

Chassis in mild steel or in larger quantities can also be supplied.

Note our new factory address

Inductance Specialists LTD

Cameron Rd. South, Greerton, Tauranga.

DIODE MODULATOR APPLICATIONS

The uses of diode modulator can be separated into two general categories (see Fig. 1):

I. **High Impedance** — over 500K load impedance (generally constant current sources).

II. **Low Impedance** — less than 500K load impedance (generally 1 to 100 ohms source impedance).

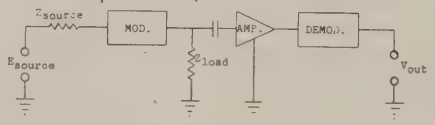


Fig. 1.

I. High Impedance

The critical factor in high impedance applications is the unbalance of the inverse leakage current. The best way to insure a **low unbalance** of leakage current is to require a **low maximum** leakage current for each diode. Since the load impedance is high, the small unbalance of the forward characteristics will be negligible.

The modulator described is superior to both silicon and germanium transistor modulators in high impedance applications. This is because its leakage current is significantly lower than the Ico of available transistors. It is superior to mechanical choppers due to the absence of stray fields, reduced size and weight, as well as elimination of moving contacts.

II. Low Impedance

The critical factor in low impedance applications is the stability of the null voltage. The Q-31 has very good null voltage stability when operated in a restricted temperature range. Typically, it will be stable within ±50 microvolts for 1 hour of operation, or ±150 microvolts for 1 day of operation at 25°C ±1°C. Operation over a broad temperature range will, of course, cause the unbalance voltage to change. The unbalance of the Q-32 will not exceed 10 millivolts over the —65°C to +100°C temperature range. With a small load impedance, the unbalance due to inverse leakage will be negligible.

In the milliampere range, this type of modulator is superior to silicon transistor modulators in low impedance circuits because of the high series collector resistance found in small signal silicon transistors. Germanium transistor modulators, however, have less unbalance in low impedance circuits when the temperature is maintained at a low value. At temperatures above 75°C, the Ico problem becomes large enough to consider the use of the Q-32 instead. Mechanical modulators have excellent electrical characteristics in low impedance circuits, but may be ruled out because of size, weight, shock, or vibration problems.

CIRCUITS

Two of the circuits frequently used with modulator quads are:

A. The Half-wave Modulator (Bridge Modulator)

B. The Ring Modulator

A. The Half-wave Modulator:

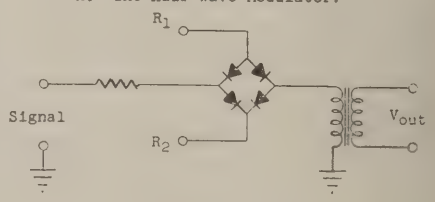


Fig. 2

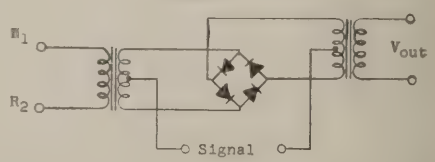


Fig. 3

The modulator units described are wired so that use in either circuit is practical.

A. The Half-wave Modulator

The half-wave modulator allows operation with single-ended loads and sources. Its output is a square

wave with an RMS amplitude equal to one-half of the signal input voltage.

B. The Ring Modulator

The ring modulator is frequently used where balanced loads are possible. Its full wave operation results in greater circuit efficiency. Its output is a square wave with an RMS amplitude equal to the signal input voltage.

In both circuits, the modulator arrangement is switched back and forth by a drive voltage applied to terminals R_1 and R_2. Although a reasonably good output null can be obtained using a sine wave drive, optimum performance may be realized by using a **square wave** drive. The square wave should supply approximately 1.0 milliamperes through each diode in the forward direction, and not more than 6 volts in the inverse direction. A suitable square wave can be generated with a zener diode clipper (Fig. 4) or with a transistor clipper (Fig. 5) driven by a sine wave.

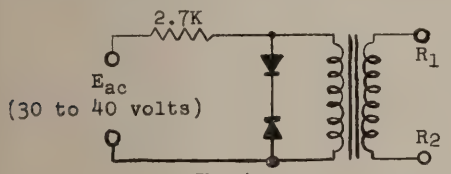


Fig. 4

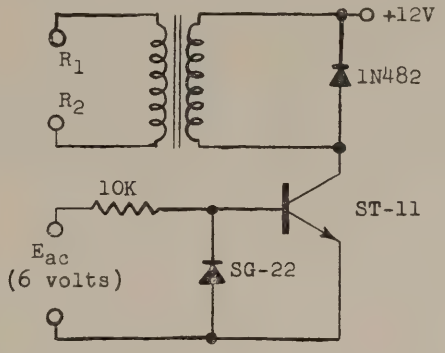


Fig. 5

The null voltage under controlled temperature conditions, with square wave drive, is extremely small at frequencies of 1000 cps or less. This null voltage is limited to 50 microvolts maximum for the Q-31 when measured in the prescribed circuit. Null voltage at higher frequencies is determined largely by the characteristics of the transformers used. Figure 6 indicates the average null voltage as a function of frequency.

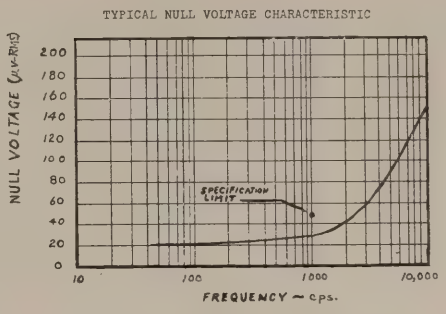


FIGURE 6

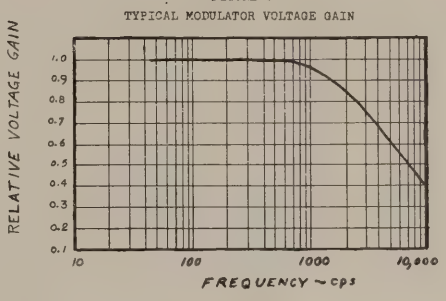


FIGURE 7

The modulator voltage gain also is dependent on the transformers used. Figure 7 indicates how it can drop off with frequency with a typical transformer combination.

(The modulator units described are available from Transition Inc., USA. Ed.)

Radio—Canada Centennial Essay Contest

Any shortwave listener living outside Canada is eligible to enter the Radio-Canada Centennial Competition. The contest is limited to one entry per person.

The competition is for the best essay entered on the theme "Man and His World". This essay must not have more than one thousand words and should be type-written on one side of the paper only, in one of the eleven languages used by Radio-Canada. "Man and His World" is the theme of Expo 67, the Universal and International Exhibition which is being held in Montreal from April to October 1967. This theme will encompass broadly the following three points:

(1) How man's environment affects him.
(2) How man changes and improves his environment to realize his aspirations.
(3) How, in turn, he is influenced by his new achievements.

There will be up to twelve major prizes, each of which will consist of a seven-day stay (7) for two in Montreal to visit Expo 67 during the period from 15 May 1967 to 15 September 1967. This includes two return airline tickets, accommodation in Montreal, free entrance to Expo 67, and a daily allowance of $20 Canadian per couple for meals and other expenses. There will also be secondary prizes for the runners-up in the competition, consisting of publications about Canada and the Centennial of Confederation.

The opening date for this Radio-Canada Centennial Competition is July 1966 and the closing date, September 1966. Entries received in Montreal after midnight, September 30, 1966 will not be considered by the judges.

Competition entries will be considered by a panel of experts, including a University professor, a member of Expo 67 management and a senior member of Radio-Canada management as chairman.

The winners of the competition will be announced in broadcasts of Radio-Canada during the first week of January 1967. Additionally, all winners will be personally notified.

In order to enter the Competition, official entry forms will be required and are available upon request.

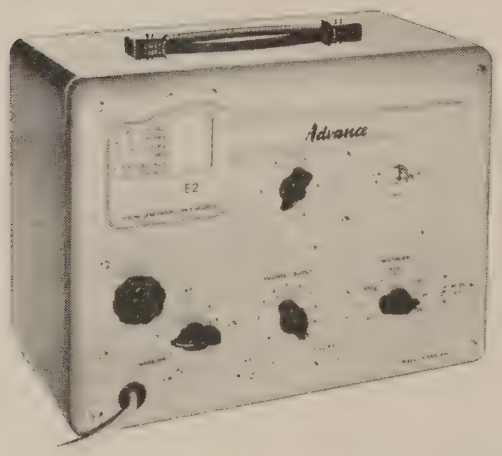
All essays entered shall become the sole property of the Canadian Broadcasting Corporation, International Service. Every contestant shall be required to sign a statement to this effect on the entry form which must accompany the essay. The decision of the panel of judges will be final.

All enquiries should be addressed to:—

Centennial Competition,
Radio-Canada,
P.O. Box 6000,
Montreal, Quebec,
Canada.

ENQUIRY CARD AD. 18

Advance r.f. signal generators

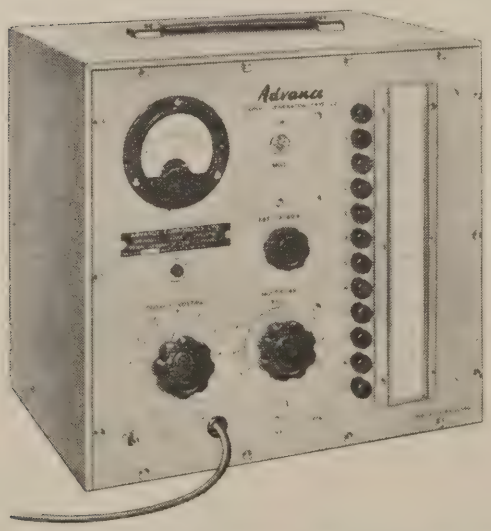


E2

R.F. Signal Generator

Frequency range 100kc/s to 100Mc/s in six bands. *Calibration accuracy* ±1%. *Output* Approximately 1V at the full R.F. socket. Continuously variable 1μV to 100mV. Accuracy of maximum output ±3dB. Accuracy of step attenuator ±(3dB + 3μV). *Output impedance* 75Ω unterminated. Normally this is matched with a 75Ω terminating pad TP1B, providing 37Ω, 10Ω and a standard 10Ω dummy aerial. *Modulation* INTERNAL 30% ±5% at 400c/s ±10%. EXTERNAL 0 to 80%, 10c/s to 4kc/s; 0 to 40% at 10kc/s. *A.F. output* 0 to 50V, 400c/s into high impedance. *Leakage* Less than 3μV. *Power requirements* 105 to 125V and 210 to 250V, 40 to 100c/s, 20W.

Dimensions 13in (33cm) wide × 10¼in (26cm) high × 8in (20·3cm) deep.
Weight 17½lb (8kg).



C2H

R.F. Signal Generator

Frequency range Twelve spot frequencies in the range 30kc/s to 40Mc/s. *Output* Continuously variable 1μV to 100mV. *Accuracy* Below 10Mc/s, ±1dB ±1μV; 10 to 40Mc/s, ±2dB ±2μV. *R.F. level* The R.F. level between push-button settings does not vary by more than ±3%. With ±10% a.c. supply variation, the output level change will not exceed ±3%. *Output impedance* 75Ω unterminated. *Modulation* Carrier internally amplitude modulated 30% ±5% at 400c/s ±5%. *Power requirements* 100, 210, 230, 250V, 40 to 100c/s, 25W. *Dimensions* 12½in (31cm) wide × 13½in (33·7cm) high × 10in (25·4cm) deep. *Weight* 28lb (12·7kg).

ADVANCE ELECTRONICS LIMITED ENGLAND

Sole New Zealand Representatives

TURNBULL & JONES LTD.

Auckland Wellington Christchurch Dunedin

FROM THE COMPREHENSIVE RANGE OF Advance INSTRUMENTS AND EQUIPMENT

Book Reviews

MATRIX ALGEBRA FOR ELECTRONIC ENGINEERS
by Paul Hlawiczka
Published by Iliffe Books Ltd., London, 1965
45s. 0d. 216 pages

This is a fine example of the self-explanatory textbook — a rare phenomenon in this day and age! Hlawiczka could well have entitled this "Teach Yourself Matrix Algebra", for it does precisely that, and students with only elementary algebraic and electrical knowledge should have no difficulty in following the text.

The book is divided into two main parts. The first of these provides an introduction to the subject and a complete statement of the basic rules together with a section covering equations of linear two-part networks. The second part is rather more advanced, but still readily comprehensible, and commences with a section extending the basic arguments of the first part. There then follow sections on the solution of differential equations of passive linear networks, and wave matrices. I would have liked to see an inclusion here of a section dealing with problems arising in circuits with periodically varying parameters, but the author presumably considers this outside the scope of the book.

My only criticism is that the text is inclined to be lengthy and a little cumbersome in places. It has clearly been Mr Hlawiczka's desire to provide as simple a treatment of the subject as possible, and I feel he has overdone this by his rigid step-by-step arguments throughout. I also consider the inclusion of the problems at the end of the book was unnecessary. Examples should only be included when they are legitimate extensions of the text. In this case they are not.

These, however, are minor points and overall I liked this book very much indeed. It will be a valuable addition to any physics or electrical engineering student's library, and, as such, I unhesitatingly recommend it.

J.H.B.

TRANSMISSION LINE THEORY
by Ronald W. P. King
Publ.: Dover Publications Inc. N.Y.
pp 504 Price: $ (U.S.) 2.75

This book, which is a reprint of one published in 1955, is solely concerned with the mathematical concepts of the theory, practical techniques are not considered.

The development is in logical sequence. The first chapter deals with infinite lines of various geometries (shielded lines, both coaxial and eccentric, multiple wires, both shielded and open, strips and cylindrical wires over infinite planes etc), considered both from the conventional standpoint and by a discussion of the electromagnet field. The second extends these results to terminated lines of finite length in which the "terminal functions" are introduced. The third chapter deals with the impedance of finite sections of line and their use for matching in transformers, baluns, hybrid junctions etc. whilst the fourth considers current voltage distributions, the transfer of power and an analysis of the distribution and resonance curves. The work concludes with chapters on the effects of discontinuities (including non-uniformities), and line oscillators.

This is by far the most comprehensive treatment of the subject that this reviewer has met and is essential to any worker concerned with the theoretical aspects of transmission lines. One word of warning, it is highly mathematical and a considerable knowledge of mathematics is assumed.

D.W.C.

ELECTRO DYNAMICS
by Leigh Page and Norman Ilsley Adams Jr.
Publ.: Dover Publications, N.Y.
pp 500 Price: $ (U.S.) 2.50

This is a mathematical physicists book and is concerned with the mathematical aspects of electro dynamics: except where they appear incidentally, electrostatics and magnetistatics are not considered. With such a mathematical treatise it is not possible to provide a detailed description of the material presented, but a list of the main sections may be helpful.

The book begins with a comprehensive treatment of vector analysis introducing the theorems and operators which form the basis of the subsequent development. This section is followed by one on the principle of (special) relativity. The equations of the electromagnetic field are deduced on the basis of emission theory. A section on the elementary force and charge equation leads up to a consideration of the phenomena in material media. Radiation and radiating systems are treated at length and a section is devoted to the electromagnetic theory of light. The book ends with papers on four dimensional analysis and general dynamical methods.

This book " . . . is an unabridged and unaltered republication of the second (1945) printing of the work first published in 1940 . . . ". It follows that there can be no treatment of modern theories of conduction in semiconductors; in addition the development is in terms of the now discarded dyadics rather than tensure and will be difficult to follow by the present day reader. In view of this it is difficult to see why it was found necessary to reissue the work.

D.W.G.C.

ENQUIRY CARD AD. 21

Radio Mr Serviceman

Our radio broadcast universal replacement coils will replace any damaged aerial, R.F. or oscillator coil. Designed to assist you in maintaining first-class service to your clients.

Aerial Type 40
R.F. Type 45
Osc. Type 41

Write for alignment procedure Sheet № 5/40

New factory address:
Cameron Rd. South, Greerton, Tauranga

Inductance Specialists LTD.

ENQUIRY CARD AD. 19

HEROS BIAS SUPPLY AND BATTERY ELIMINATOR

This unit has been specially designed for servicemen to give them a versatile unit in compact form supplying the requirements of a **Twin** bias unit for AGC measurements in TV receivers as well as a **fully regulated** power supply and battery eliminator for transistor servicing.
Fully metered both volts and amps thus providing also the facility of giving the technician the operating voltage and current consumption of the receiver under test.
The instrument is virtually self protecting in case of accidental overload plus the addition of a fuse in the secondary side of the transformer. This protects against filter or rectifier failure.
Components have been chosen to give long life and satisfactory performance under normal conditions of use.

Specifications :

Input:	230 volts 50c/s AC
Outputs:	Bias 1. 0-15v Bias 2. 0-15v Batt. Eliminator 12v at 300ma
Ripple	less than 1%
Regulation	better than 1%

HEROS

Warranted against faulty workmanship and materials for six months

ORDER YOURS NOW FROM

DISTRIBUTED BY:

P. H. ROTHSCHILD & CO. LTD.

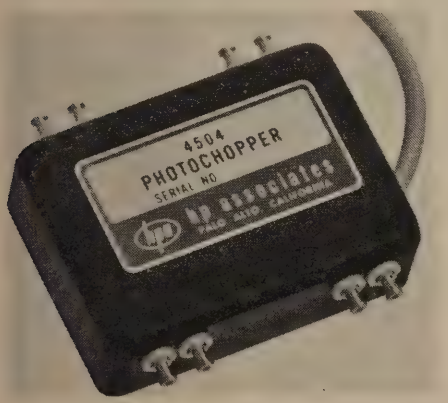
P.O. BOX 30-170 LOWER HUTT **83 PRETORIA STREET** **TELEGRAMS "FRANDS"**

New Products

PHOTOCONDUCTOR CHOPPERS

The first of a new line of Photoconductor Choppers utilising specially designed hermetically sealed photocells manufactured by HPA, have been announced. The HPA 4503 and 4504 are double-pole double-throw externally driven photochoppers capable of operating at chopping frequencies up to 1 kHz and of efficiently modulating DC signals in the sub-microvolt level with a minimum of generated noise and offset. The modulation and demodulation process is accomplished synchronously by illuminating the photocells with self-contained neon glow lamps of high quality and uniformity, stabilised and selected to provide long life and reliable operation.

The HPA 4503 features a high impedance modulator for use with high input impedance amplifiers and the HPA 4504 features a low impedance modulator for use with low amplifiers. The demodulator of both types is intended for use with a low output impedance amplifier and provides an effective output impedance on the order of 50 KΩ.



The photoconductive material used in the individual cells has been developed to provide the optimum compromise between switching speed, providing high efficiency at high chopping frequencies, and temperature stability. In DC chopper amplifier applications HPA photochoppers offer major benefits such as: long life, no acoustic radiation, low required drive power, large input dynamic range capability, application proven in low level dc amplifiers, low profile for p/c board mounting and high degree of isolation between drive and inputs.

A data sheet is available with detailed specifications and typical parameter variations vs. chopping frequency given for both types.

ENQUIRY 295

* * *

ACTIVE PROBE FOR DIGITAL COUNTERS

This SA.544 accessory is an active probe which increases both sensitivity and input impedance of the Racal direct-reading digital counters types SA.540 and SA.550. The SA.544 is the first such accessory offered by any digital instrument manufacturer, and the two counters are the first to accept such a probe.

Use of the Active Probe enhances counter performance typically increasing counter input impedance to 10 MΩ in five ranges and sensitivity to 5 mV, making possible many measurements over the 100 Mc/s frequency range which were hitherto only possible using special external amplifiers and impedance-matching devices. The high inherent accuracy of the counter is retained for all measurement functions.

The Probe, which makes exclusive use of semi-conductor devices, is powered directly from the associated counter. It is of rugged construction and designed to withstand the severe environmental operating conditions imposed by military application.

ENQUIRY 274

* * *

CLEANING SOLVENT

Precision cleaning is simplified with this cleaning solvent. Only small amounts are required, particularly in wiping and swabbing operations. Cleaning is fast, too, because many components need not be disassembled. It will clean certain plastics and so remove some types of photo-resist materials from printed circuit boards. It has no effect on the common constructional metals. Mechanical agitation may be necessary for some tenacious soil.

The solvent has good penetration into blind holes, recesses and cavities and is easily recoverable by distillation. It is non-inflammable and less toxic than many other cleaning solvents. It is used cold.

ENQUIRY 296

* * *

SPECTRUM ANALYSER PLUG-INS

Seven new spectrum analyser plug-ins, for use with any Tektronix oscilloscopes that accept letter series or 1-series plug-ins are now available.

The plug-in units cover the range of 2 to 18 gigacycles and provide low-cost microwave analysis capabilities equally suitable for field service, laboratory test, design analysis, and permanent installation in system "checkout" equipment.

High sensitivity makes the separation of weak signals, RFI, or spurious signals, routine. This high sensitivity is achieved through use of fundamental and low-order harmonic conversion.

All plug-ins employ a calibrated, multi-turn frequency dial for accurate readout. Resolution band-width is continuously variable from 1kc to 100kc. A separable waveguide mixer is provided with the model L-3852/3 (11.8 to 15.2Gc) and Model L-5862/3 (14/8 to 18.2Gc). The unknown signal is heterodyned in the mixer by the local oscillators third harmonic, and the RF returned to the plug-in module. In practice, the waveguide mixer is connected to the Ku-band Waveguide and two cables run to the analysers.

Characteristics common to this entire group of analysers include display flatness of plus or minus 3db, low incidental FM of 800 to 1800 cps. at local oscillator fundamental, I.F. attenuation of 51db in 1-db steps and single or picket-fence markers, continuously variable plus or minus 30Mc, with picket-fence separations of 100kc and 1Mc. Associated displays are log, linear, square law and video.

ENQUIRY 293

* * *

LOW COST SILICON CONTROLLED RECTIFIERS

A.W.A. have announced the availability of a low cost RCA SCR series, which now makes it possible to switch 35 amps from a standard 230 volt mains supply at less than 2s. 9d. per amp. These units which have a forward current rating of 35 amperes RMS, have a forward blocking voltage capability of up to 600 volts and are available in either a stud package 2N3896 - 2N3899 or a press fit package 2N3870 - 2N3873, which allows for maximum design advantage.

In the lower current range A.W.A. provide RCA types 40378 and 40379, which have a forward current capability of 7 amperes RMS and a repetitive PRV rating of 200 and 400 volts respectively. These units have a low profile package and are intended for use in ultra compact systems.

ENQUIRY 289

* * *

XY PLOTTER

Now available, the Bryans 21000 Series XY Plotter is a new and inexpensive model which complements the company's existing range. The 21000 provides facilities which have only been offered previously on more costly units.

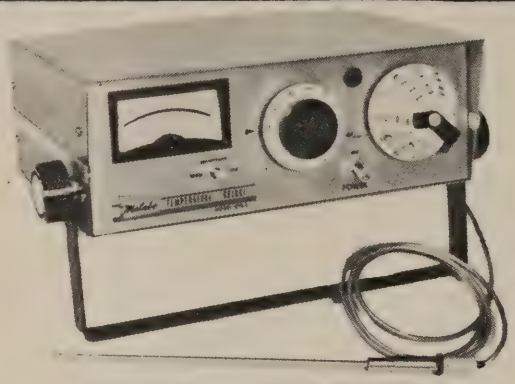
Features include high impedance floating input circuits, sensitivity of 1mV./in. to 1V./in. (500μV./in. to 5mV./in. in potentiometric mode), good a.c. and d.c. common mode rejection, accuracy of 1% over full scaling range of 3 decades, offset zero in both axes and modular construction. Models can be supplied with both inches and metric scaling.

Accessories include a solenoid operated pen and a rack mounting attachment. An optional time base with sweep speeds of 0.5 to 50 sec./in. will shortly become available. Bryans Ltd. is represented in New Zealand by E. C. Gough Ltd.

ENQUIRY 294

ENQUIRY CARD AD. 36

focus on our agencies



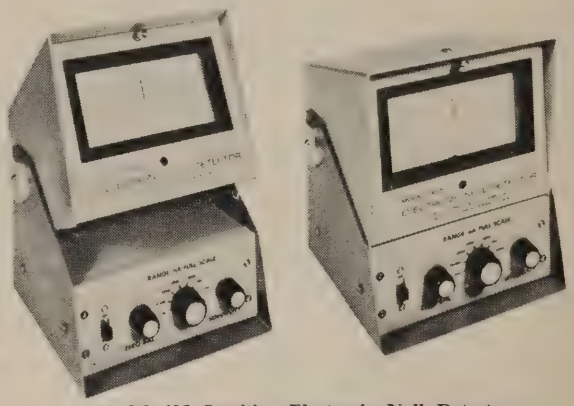
Model CTB — 1 Temperature Bridge

MELABS U.S.A.
All solid state CTB—1 furnishes you with temp. readings —200 to +400°C via clearly displayed dekastat readout with clean scaled last two digit meter display. This instrument produces highly accurate absolute and relative temp. measurements in liquids, solids and gases. Accuracy is 20 m° within ± 50° C of calibration point. Sensitivity for relative readings of ± 5m° at —200°C to ± 1m° at 400°C.

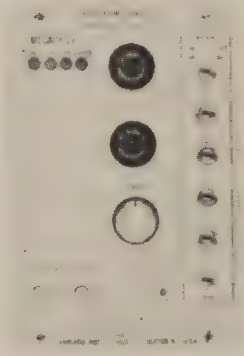
PRICE £362/5/- (N.Z.) delivered.

Calibrated sensor traceable to National Bureau Standards available as an extra accessory. PRICE £94/10/-.

R.F.L. RADIO FREQUENCY LABORATORIES INC. U.S.A.
Announce their new solid state, tilthead, completely portable null detector.
Ranges: From 0 – 10 to 0 – 10,000 nA
4 F.S. positions with better than 1 nA resolution.
Features: High sensitivity both variable and fixed.
4½" taut band meter display.
Int. components meet A.S.A. and N.E.M.A. Specs.
Ext. socket for recorder operation.
Applications: Ultra precise null balancing for potentiometers, bridges, etc. With appropriate source voltage; measurements of extremely low level leakage currents can be effected. PRICE yet to be released.



Model 485 Sensitive Electronic Null Detector



Type 74 — 96A Spectrum Analyser Tuning Unit

FAIRCHILD INSTRUMENTATION U.S.A.
Type 74 – 96A covers 600 KHz – 36 MHz in 4 bands displayed on precision slide rule scale with up to 51 dB of input attenuation in 1 dB increments.
Resolution: Total excursion about the set frequency is 10, 35, 100 Hz and 2 KHz.
Min. Sensitivity: Tangentially – 100 dbm at 10 Hz resolution optimised at 100 Hz f.s. sweep width.
Display flatness: ± 1 db – 5 KHz/Div. ± 2dB above.
Frequency stability: I.F. – 2ppm/°F. 0.25 ppm/volt line.
Local oscillator: —150 ppm/°F. 1 ppm/volt line.
Maximum input power: 0 dbm without R.F.
Attenuation: + 25 dbm with R.F. attenuation.
Unit fits in Fairchild 765H series Oscilloscope and extends spectrum analysis into the Microwave region.
Ext. tuning extends unit far above 36 MHz.
PRICE (N.Z.) £660.

PRICES SHOWN DELIVERED DUTY PAID ANYWHERE IN NEW ZEALAND

WE ARE SOLE AGENTS FOR:

BOONTON RADIO COMPANY (U.S.A.)
DECKER CORPORATION (U.S.A.)
EITEL-McCULLOUGH INC. (U.S.A.)
FAIRCHILD INTERNATIONAL
HEWLETT-PACKARD ASSOCIATES
KEITHLEY INSTRUMENTS INC. (U.S.A.)
MIKROS INCORPORATED (U.S.A.)
NUCLEAR CHICAGO
RADIATION INSTRUMENT DEVELOPMENT LABORATORIES INC. (U.S.A.)
A/S DANBRIDGE (DENMARK)
DU MONT LABORATORIES (U.S.A.)
ELECTRONIC MEASUREMENTS CO. INC.
JOHN FLUKE MNFG. CO. INC. (U.S.A.)
HEWLETT-PACKARD COMPANY (U.S.A.)
MELABS (U.S.A.)
F. L. MOSELEY COMPANY (U.S.A.)
GEORGE A. PHILBRICK RESEARCH INC.
SANBORN COMPANY (U.S.A.)
TALLY CORPORATION (U.S.A.)
DATAPULSE INCORPORATED (U.S.A.)
DYMEC INCORPORATED (U.S.A.)
ELECTRO SCIENTIFIC INDUSTRIES (U.S.A.)
HARRISON LABORATORIES
HOLT INSTRUMENT LABORATORIES (U.S.A.)
MICA CORPORATION (U.S.A.)
NESCO INSTRUMENTS INC (U.S.A.)
RADIO FREQUENCY LABORATORIES (U.S.A.)
S-E LABORAORIES LTD. (ENGLAND)
TECHNICAL RESEARCH GROUP INC. (U.S.A.)

S

SAMPLE ELECTRONICS (N.Z.) LTD.

8 MATIPO STREET, ONEHUNGA, S.E.5. AUCKLAND, NEW ZEALAND

TELEPHONE 567-356

SERVICE AND CALIBRATION FACILITIES AVAILABLE

Electronic Telephone Exchange Uses Reeds

During the course of one working day, a single automatic telephone exchange serving 10,000 subscribers in any large city, will receive and take action on well over 10,000,000 separate 'bits' of information. In any national telephone system there will be hundreds of such telephone exchanges working together, simultaneously receiving and routing calls in all parts of the country.

Yet the world's telephone exchanges are still mechanically operated, using electro-mechanical devices such as motors, springs, levers etc. The increasing demands of modern telecommunication users, which have necessitated intercontinental dialling and the interconnection of data processing installations, highlight the limitations of existing telephone switching techniques and indicate the necessity for a high speed transistor switching system compatible with the range and operating speeds of satellite communications.

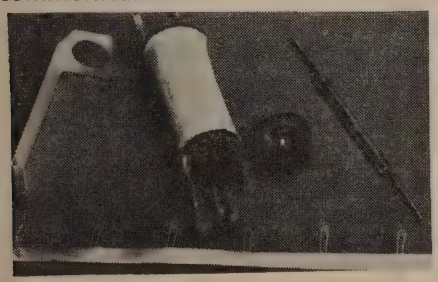


Fig. 1
The reed relay and its elements (bobbin, end cap, screen and insert). The ribbon cable used for commoning inlets and outlets is also shown.

An electronic exchange has been developed to meet these requirements. Known as REX (Reed Electronic Exchange), it employs reed relays for the switching functions which are electronically controlled.

The Reed Electronic Exchange System has been developed to provide compatibility with all existing automatic telephone exchange networks. It can be supplied for new exchanges or as a direct extension of electro-mechanical exchanges or used for the progressive conversion to electronic operation of telephone exchanges nearing the end of operational service. Among the important technical advances incorporated in the system is an entirely new construction technique which enables equipment for more than 20,000 subscribers to be accommodated in the space normally required for 10,000 circuits in an electro-mechanical exchange. A REX system can serve an area three times that of a conventional exchange with significant reduction in line plant costs.

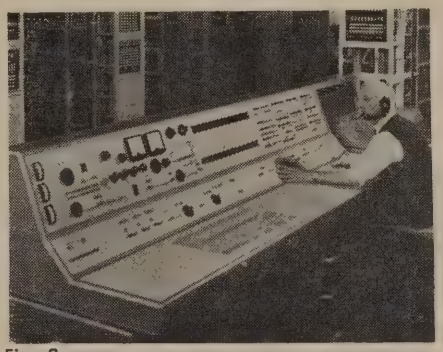


Fig. 2
An engineer working on a test console which is designed to test both the subscribers line and the exchange equipment. It uses keys and rotary switches for selecting all test circuits instead of the normal plugs and cords.

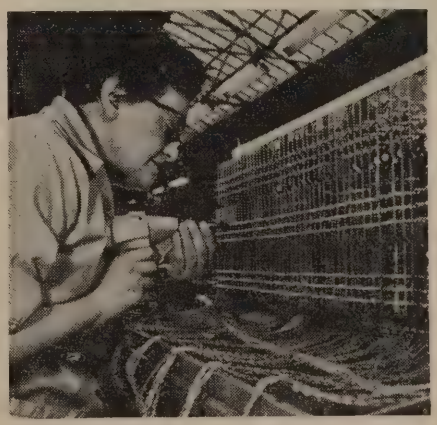


Fig. 3
An engineer making final checks on a rack carrying electrical apparatus and reed relay switching arrays.

The electronic control uses the advanced stored programme technique. It is simple in operation, with self-checking and reporting facilities for maintenance purposes. Designed for unattended operation it can report all servicing requirements to a distant maintenance control centre. The basic design permits all future switching facilities likely to be required by a modern telecommunications network, such as abbreviated dialling and subscribers' automatic transfer, together with standard features such as data for automatic message accounting, to be provided at a reasonable cost.

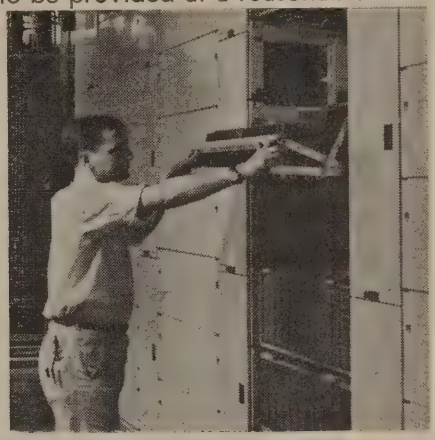
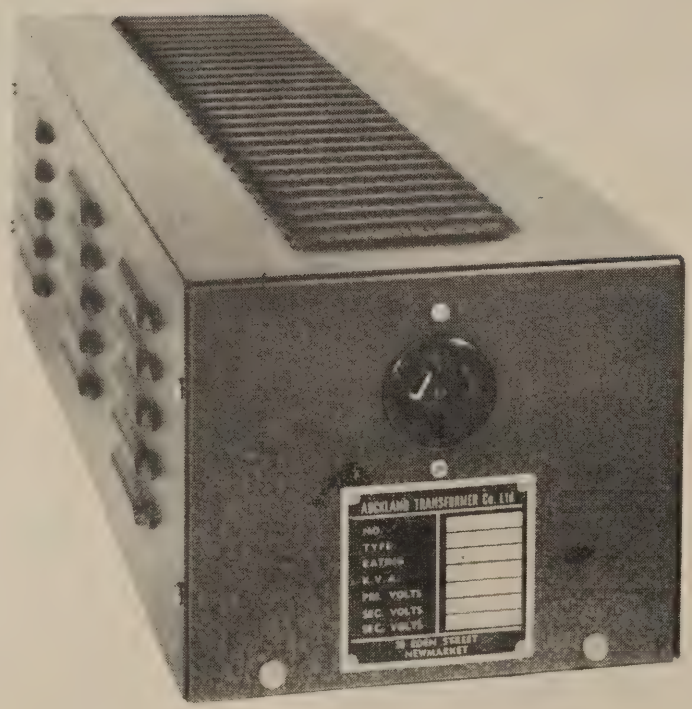


Fig. 4
Terminating the wiring on an electronic panel. Exclusive use has been made of wire wrapping techniques and the operator is using a high speed wire wrapping gun.

Existing telephone exchanges throughout the world operate by space-division techniques and use electro-mechanical switches throughout. In the electronic system, these switches are replaced by reed relays. Each relay provides, by virtue of its position in space, a route from a source to a destination. The energisation of a particular coil, to close the reed contacts, is the function of separate control equipment. The reed, being simpler than any other contact, is more reliable; it also offers a better transmission path, requires no routine maintenance, sets up no vibration and is immune from interference by dust and atmospheric pollution. Each reed relay consists of four reed inserts within a single coil. A reed insert consists of two strips of magnetic nickel - iron alloy, the ends of which are gold fused and overlap with a small gap between them. Each insert is hermetically sealed in a glass tube containing a dry gas. A current through the coil causes the two strips of each insert to make contact, and thereby connect the inlet and outlet ends of the relays together. Cross point switches are formed by arringing a number of reed relays in a matrix.

ENQUIRY CARD AD. 8



What's so different about ATC products?

These products are the result of sound design, wide experience, technical know-how, quality control, coupled with the desire to help with nidividual problems as well as manufacture stock lines.

You have known us as transformer manufacturers. But did you know our range includes this new series of CONSTANT VOLTAGE TRANSFORMERS, which are suitable where mains voltage variations must be overcome to give constant R.M.S. output — especially constant light and heat.

GENERAL SPECIFICATIONS—
230 volts RMS ± 1% output for mains variation of 190 volts — 260 volts ± 15%. 4 ratings: 150, 250, 500, 1000 watts.
Our designers can offer advice on non-standard applications.

• Write for our new catalogue.

AUCKLAND TRANSFORMER CO LTD.

20 EDEN STREET, NEWMARKET, AUCKLAND

PHONES 51-307, 549-280, 544-126 TELEGRAMS "TRANSFORMA"

New Products

MANPACK TRANSCEIVER

Squadcal, the new Racal lightweight HF/SSB manpack transceiver with 29 channels in the frequency range 2-7 Mc/s, has been designed for the most severe conditions likely to be encountered. It is suitable for military and quasi military forces, being simple to tune and operate, low in cost, waterproof and lightweight (approx. 18 lbs.).

It has been extensively tested in many parts of the world, including monsoon conditions in the Far East. Squadcal has an output power of 5 watts p.e.p. and can be used with either whip or wire aerials which are supplied. Alternative power units employing dry or re-chargeable batteries or vehicle battery are available.

The equipment is also suitable for AM or CW operation.

ENQUIRY 283

* * *

PUBLIC ADDRESS SYSTEM

The a.c. powered silicon solid state AU-500 public address system has been announced by Concord Electronics Ltd. It features a complete 10 watt p.a. system in one lightweight cabinet — ideal where portability, speed and ease of setting up are essential.

The transistor amplifier drives a four-speaker sound column for most efficient sound distribution. The column radiates most of its sound in the direction it faces, eliminating most feedback problems. Inputs are provided for gramophone player and microphone with full mixing facilities.

Tone controls comprise independent bass and treble and a voice/music switch. Space is provided in the cabinet's base for microphone and cable. The unit has an attractive vinyl cabinet covering and grille cloth. A handle is provided. The chassis unit is available separately with output matching transformer and vinyl-covered case. This model (the AU-501) matches into 3, 8 or 15 ohm speakers or to a 70 volt or 100 volt line.

Specification:

Frequency Response:	50 to 50,000 Hz ± 2 db. 100 to 40,000 Hz ± 0.5 db.
Power Output:	10-watts RMS into 12 ohms
Harmonic Distortion:	2% at full output
Input Sensitivity:	microphone 5 mv pickup 500 mv
Power Consumption:	30-watts

Bass cut switch — operates below 400 cps

Speakers — 4 Philips AD3800M 8" dual cone

ENQUIRY 278

ELECTRICALLY CONDUCTIVE CLOTH

A group of electrically conductive textile fabrics with controlled resistivities over a wide range has been developed by a U.S. company with international interests. Known as Ucar electrically conductive cloth, the new composite material can be used as a heating element in configurations from narrow ribbons to large blankets. One of the first commercial applications is in seat heaters for 1966 automobiles.

The new cloth is made by weaving conductive carbon yarn with insulating glass yarn. Electrical conductivity is a natural attribute of carbon yarn and the yarn can be compared to high resistance wire. Another suggested use is as a permanent high-resistance path to bleed off static electricity.

The loss of a single carbon yarn causes only a barely perceptible change in performance for reliability. Resin laminates incorporating Ucar cloth can be designed with conductor-resin interface areas many times those of equivalent wire elements. Thus the interface temperature is reduced, lessening the chance of resin charring that could short out the element.

Ucar conductive cloth has the flexibility, hand, and drape of glass drapery fabrics. Suggesting applications such as heated clothing, bedding, and cushions.

This carbon/glass conductive cloth can be easily made into rigid and semi-rigid laminates of suitable resins and

CUT HERE

ADVERTISEMENT & PRODUCT ENQUIRY SERVICE

TO OBTAIN MORE INFORMATION ABOUT PRODUCTS OR SERVICES MENTIONED IN THIS ISSUE FILL IN ITS NUMBER, YOUR NAME AND ADDRESS, CUT OUT THE COUPON, AND POST IT.

1st FOLD

If you require your own subscription postage free each month fill in here — we will invoice you.

Please send me RADIO, ELECTRONICS AND COMMUNICATIONS for

12 months 30/-
24 months 50/-

NAME .....

ADDRESS .....

TUCK IN

3rd FOLD

AUTHORITY No. 1231 AUCKLAND, N.Z.

BUSINESS REPLY POST

Postage will be paid by

THE MAGAZINE PRESS LTD.

P.O. BOX 1365

AUCKLAND

2nd FOLD

FIX HERE

reinforcing fibres and fabrics for such applications as aircraft deicers.

Maximum continuous operating temperature recommended for Ucar conductive fabrics is from 450° to 550° F. By proper selection of yarn and weaving pattern, resistivity of the material can be varied from approximately 0.2 to 30 ohms/square. Power densities as high as 15 watts per square inch have been handled successfully in intermittent service.

A number of methods are available for making electrical connections to the cloth. Light clamping pressure can handle relatively high current densities, and the cloth can also be soldered and sewn.

ENQUIRY 271

* * *

1Kw HF LINEAR AMPLIFIER

This TA. 349 Speedrace covers the frequency range 1.5-30 Mc/s and is suitable for DSB, ISB, SSB, or CW operation. Two versions are available, one with full automatic tuning, the other manually operated. Alternative power units for single or three phase supplies with frequency drive equipment, including synthesizers, available. The TA.349 is designed to meet stringent requirements of military organizations in temperatures from — 10°C to + 55°C with high humidity. The complete amplifier, power unit and blower is accommodated in a height of 35 in. of a standard 19 in. width rack.

ENQUIRY 285

ROTATABLE LOG ANTENNA

The Hy-Gain LP-6/40R is a rotatable log periodic antenna that exhibits outstanding performance throughout the 6 through 40 megacycle frequency range. Peak forward gain over an isotropic source averages 14 db; F/B ratio, 18 db average. Power rating is 50 kw PEP with VSWR less than 2:1 when terminated into a 50 ohm transmission line. Rugged construction insures wind survival in excess of 125 mph. All hardware is stainless steel. Insulating material is epoxy impregnated fibreglass. Also available in lightweight air transportable model LP-1100.

ENQUIRY 298

* * *

MEGOHMMETER READING UP TO 20,000,000 MEGOHMS

Designed for ultra high resistance measurements the Criterion Model 1Rv megohmmeter reads up to 20,000,000 megohms (2 x 10^{13} ohms) and at test potentials is adjustable from 50-1000 volts.

Specifications:

- 6 direct reading ranges, 0.5/200M ohm, 5M/2G ohm, 50M/20G ohm, 500M/200G ohm, 5G ohm/2T ohm, 50G ohm/20T ohm.
- Test potential 50/1000 volts continuously adjustable and metered.
- Scale factors on dial for simple mental computation for resistance at 20 test voltages.
- Self-contained regulated power supply to operate from 115 volts 60 cycle. Consumes only 25 watts.
- Two four inch ruggedized anti-parrallax precision panel meters for simultaneous resistance and test potential indication.
- Guard-ring input circuit, fully protected, minimises connection error.
- Charge/discharge facility speeds measurements on capacitative circuits and ensures safety for the operator.
- Safety switch is "fail safe," removing test potential instantly.
- Accuracy ± 1% on potential, better than ± 5% on resistance even at extreme limits of the instrument.
- Can be used for CSA, UL, CAMESA and JAN insulation resistance test on electronic components.
- Attractively finished steel cabinet 15" x 8" x 9½", weighing only 12 pounds.

ENQUIRY 263

* * *

FSK/SSB RECEIVER

The RA.329 meets requirements of military and quasi-military services for a compact, transportable SSB and teleprinter receiving terminal, covering 1-30 Mc/s, with digital frequency indication of 1 kc/s with interpolation calibration of 200 c/s. It comprises the RA.217 transistorised HF receiver and FSK unit, loudspeaker/amplifier unit and connector panel. The equipment is transported in an approved military field transit case. SSB/CW/DSB reception with selection of USB or LSB, with 4 IF bandwidths. Power supplies from a.c. mains or 24 V. d.c. Designed to meet DEF.133 for temperatures between — 10°C and

ENQUIRY 284

Radio, Electronics and Communications

[ ] **Please send me, without obligation, information on the item numbers listed below.**

[ ] **Please record my subscription as detailed on reverse side.**

The FREE Postage does not apply to overseas readers.

Ref. No...... **Ref. No.**..... **Ref. No.**.....

Ref. No...... **Ref. No.**..... **Ref. No.**.....

Ref. No...... **Ref. No.**..... **Ref. No.**.....

Other .....

FREE READER INFORMATION SERVICE

Your Name ..... Position Held .....

Name of Firm .....

Address .....

.....

Nature of Business .....

BLOCK CAPITALS PLEASE

For more information on

- **ADVERTISEMENTS**
- **NEW EQUIPMENT AND MATERIALS**
- **NEW LITERATURE**

fill in the Enquiry Card number of the advertisement or product you are interested in and we will forward it to the company concerned.

APRIL, 1966

ENQUIRY CARD AD. 2

SILICON DIODE POWER TRANSFORMERS AVAILABLE FROM BEACON RADIO LTD.

R98 T.V. POWER TRANSFORMER

For R.T.V. & H. 1959 and later T.V. Sets.
Delivers 260v @ 300mA D.C. Full wave voltage doubler.
230:115v A.C. @ 300mA D.C.
:12.6v C.T. @ 5A (2 windings ea. 6.3 @ 5A).
:0—6.3—7.5—9 @ .6A. Picture tube winding.
Choke:—C36. Use 400v P.I.V. Diodes.

R103 Stereo Power Transformer

R.T.V. & H. Aug. 60. 7w Stereo.
230:245v @ 150mA. D.C.
:104v @ 150mA D.C. Voltage doubler Rect.
:6.3v C.T. @ 5A.
Choke:—C42. Use 400v P.I.V. Diodes.

R104 Stereo Power Transformer. 10w

320v @ 320mA. Voltage doubler Rect.
230:130v @ 320mA.
:6.3v @ 6A.
Choke:—C49. Use 500v P.I.V. Diodes.

R105 T.V. Power Transformer For Philips T.V. Kitsets

220v @ 420mA D.C. Voltage Doubler Rect.
230:106v @ 420mA D.C.
:6.3v @ 10A.
:0—6.3—7.5—9 Ov @ 0.3A. Picture tube Winding.
Choke:—C45. Use 400v P.I.V. Diodes.

R106 T.V. Power Transformer for Philips T.V. Kitsets

This type similar to R105 but less Picture Tube boost taps. Main Fils. 12.6v C.T. @ 5A.
220v @ 420mA D.C. Voltage Doubler Rect.
230:106v @ 420mA D.C.
:12.6v C.T. @ 5A (2 windings 6.30v @ 5A each).
:6.3v @ .3A Picture tube winding.
Choke:—C45. Use 400v P.I.V. Diodes.

R108 Small Stereo Headphone Power Transformer

250v @ 22mA D.C.
230:110v @ 22mA D.C. Voltage doubler Rect.
:6.3 @ 0.86A.
Choke:—C41. Use 400v P.I.V. Diodes.

R110 T.V. Power Transformer. For Philips T.V. Kitsets

This transformer uses full wave bridge rectifier. Requires no limiting resistor unlike equivalent voltage double types, also has advantage of no insulated capacitor and lower ripple output with smaller choke.
Output 220v @ 420mA D.C.
230:172v @ 420mA D.C. Full wave bridge Rect:
:12.6v C.T. @ 5A (2 only 6.3v winding @ 5A).
:6.3v @ .3A Picture tube winding.
Choke:—C50. Use 400v P.I.V. Diodes.

R111 T.V. Power Transformer

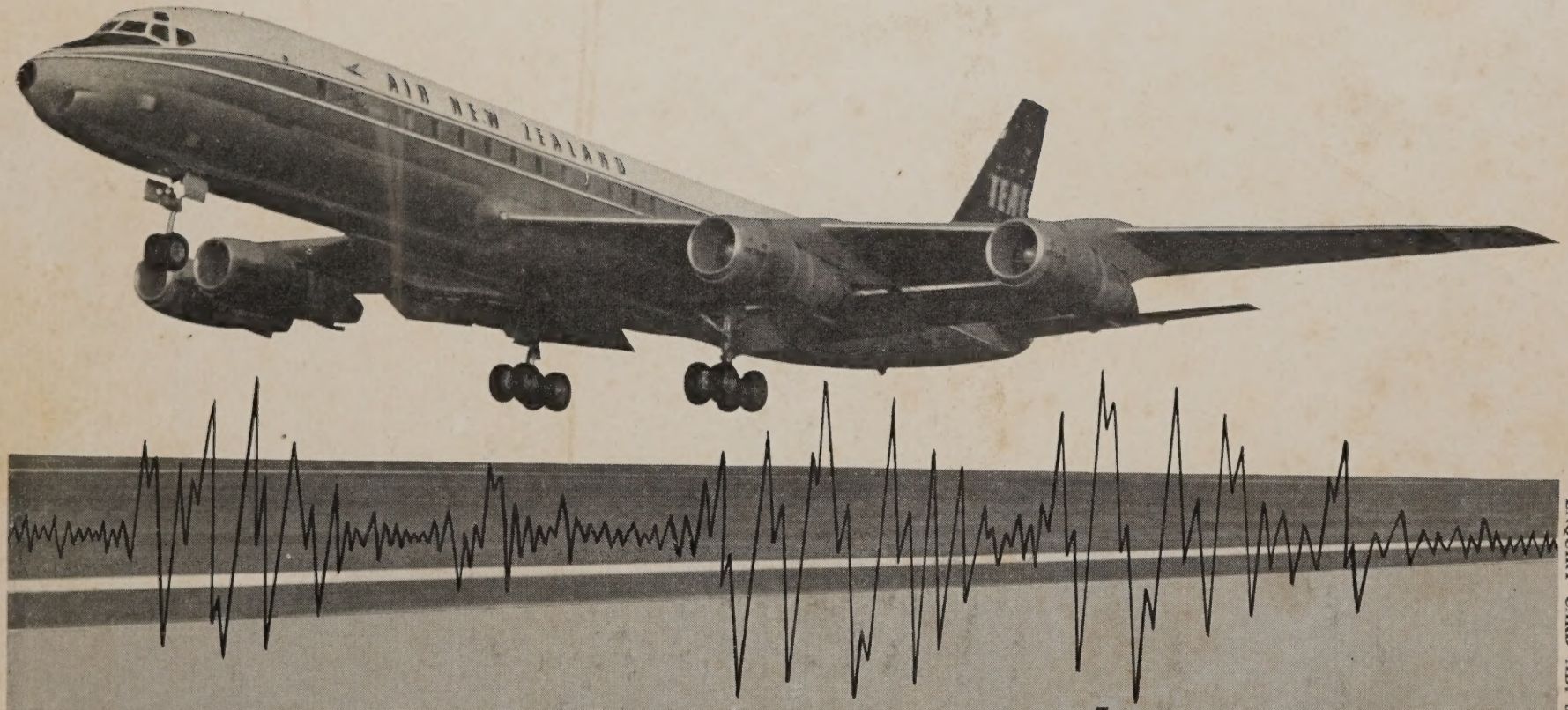
Similar to R110 but for R.C.A. type Kitsets.
260v @ 350mA from Rect.
230:207v @ 350mA D.C. Full wave bridge Rect.
:12.6v C.T. @ 5A (2 only 6.3v windings each 5A).
:6.3v @ 0.6A. Picture tube winding.
Choke:—C42. Use 400v P.I.V. Diodes.

R112 Oscilloscope Power Transformer

R.T.V. & H. 1963. Calibrated.
230:110v @ 80mA D.C. Full wave voltage doubler.
:6.3v @ 2.4A.
:6.3v @ 1A.
:6.3v @ 1A.
Use 400v P.I.V. Diodes.

BEACON RADIO LIMITED

Corner Brown and Fitzroy Sts., Ponsonby, Auckland. P.O. Box 2757. Telephone 12-168 (5 lines)



when the decibels rise

Sound level, vibration level and strain are measured throughout the world, analysed and recorded by Brüel & Kjær instruments and systems. Brüel & Kjær equipment is at present being used in New Zealand for essential research and development work by the N.Z.B.C., the D.S.I.R., Air New Zealand, the Universities and many industrial organisations. In the highly mechanised world of today, sound measuring equipment plays an all-important part, not only to measure, but to analyse and record noise level and vibration in factories, in the cities and at airports. For full details of Brüel & Kjær equipment available in New Zealand, write or call

Brüel & Kjær

ELECTRONIC NAVIGATION LTD

ELECTRONIC NAVIGATION LIMITED, 8 POLLEN STREET, GREY LYNN, AUCKLAND. P.O. BOX 5849, TELEPHONE 14-051 and 14-595.

EN.5FP